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NEW YORK, NOVEMBER 1, 1895.

EDITORIAL NOTES.

A NOTABLE marine event of the past month is the trial trip of the *St. Paul*, of the American Line, and the securing of the mail contract from the United States Government. This completes the fulfilment of the agreement between the company and the Government for the construction of two fast vessels that are to form an auxiliary navy that will be at the disposal of the Government in case of necessity, and which cost nothing to build and maintain beyond the payment of a certain sum for services rendered in carrying the mails. The whole fleet of the American Line engaged in the weekly service between New York and Southampton is now sailing under the American flag—a state of affairs that has practically existed since the *St. Louis* went into commission, though the extra steamer was still sailing under the union jack. Now, however, the four great liners, the *New York*, *Paris*, *St. Louis* and *St. Paul*, are of American register.

SINCE our last issue another battleship destined for the United States Navy has had an official trial, and has, as usual, been found to exceed the requirements of the contract, and to have earned a handsome bonus for her builders. This is no more than was expected, and is a matter to which we have become so accustomed during the past few years as to attract no particular attention and to excite no comment except on the part of those who are opposed to the payment of any bonus whatever. What has attracted attention, however, is the performances of the *Indiana* in a seaway. It was prophesied, when the designs were first made public, that the roll at sea would be so great as to be almost intolerable—a prophecy that has utterly failed of realization, for, if the reports of the run from the Delaware capes to Cape Ann are in the least reliable, there was practically no roll at all, and the *Indiana* is the steadiest battleship afloat—a fact that must cause great satisfaction to the designers and builders, especially in view of the great trouble that has been experienced with some of the vessels in the French and English navies.

IT is difficult to foretell the ultimate goal that the present tendency toward the construction of large cars will finally reach. That the "large-car" problem is one attracting wide attention is evidenced by the interest taken in it by the railroad associations. The railroads are naturally anxious to cut down dead weight and increase the paying load, the shippers are desirous of putting as much in a car as possible in order to lower rates to a minimum, and the mechanical departments are equally eager to go the other road one better by building a car of a few tons greater capacity. It does not take a very old man to remember when the 10-ton car was the standard, and the dead weight and paying load, when the car was full, were about the same. Now the ratio of paying to dead load is something more than two to one, with every one on the *qui vive* to raise it still higher. Cars of 70,000 lbs. capacity are in active service, and while there is no mechanical impossibility of raising the capacity to almost any limit, there evidently is a commercial limit beyond which it will be definitely known that large cars of heavy carrying capacity will not pay when the average available load is taken into consideration. The question is, Where is that limit?

THE NEED OF A GOOD ENGINEERING LIBRARY.

THERE was recently held in Brussels a Bibliographical Conference, the purpose of which was:

First, the foundation of an International Institute of Bibliography, having for its object the study of all questions relating to the science of book knowledge.

Second, the adoption of a universal and international bibliographical classification.

The accelerating rate of increase of literature of all kinds has made it apparent that some comprehensive system of classification is as essential to the usefulness of our rapidly growing stores of books as the books are themselves. To collect together in one building some hundreds of thousands or millions of books, without some guide to what they contain, is, as some one has said in commenting on the meeting referred to, "somewhat like placing the reader in the centre of a dense forest, and leaving him to find his way out as best he can."

This is true of general and also of technical literature, and particularly of that which relates to engineering. But in this department not only is there no classification and no guide or index, but the books themselves are not even collected together in any one place. There is nowhere in this great country where anything approximating to a complete collection of engineering books can be found. The library of the Patent Office, in Washington, is perhaps the best, and some effort has been made there to have it indexed; but owing to the unspeakable imbecility of Congress, no sufficient appropriation can be obtained from the accumulated fund which inventors have paid into the treasury of the Patent Office, for the prosecution of this important work. One of the most useful libraries of this kind is the one established by the Pennsylvania Railroad Company, at Altoona. Through the indefatigable efforts of Dr. Dudley this has had a steady growth, and the books have been collected with admirable good judgment and are available, we believe, to all reputable persons who choose to make use of them. The books are, however, stored in a combustible hotel building, and it is said that not even death and taxes are more certain than that a library thus housed will ultimately burn up. The American Society of Civil Engineers and the Mechanical Engineers each have the nucleus of a library, but the soil in which they are planted is not sufficiently fertile to produce a rapid growth.

Some years ago the subject was brought before these societies and those of the Mining and Electrical engineers, and committees of conference from each were appointed to consider ways and means of establishing a joint engineering library for the use of all four associations. Several meetings and conferences were held, at which the inability of civil engineers for co-operation with others was revealed, and although a good deal of talk was indulged in, and various members of the committees set forth, with much fervor, the importance of having a good engineering library and the value which it would be to the "profession," no workable plan was ever presented for its formation, and the movement finally died of inanition. At various times different persons have brought forward schemes for the construction of a building, in which the various societies were to be housed, each with rooms of its own, but with a common meeting hall and library. There were to be stores below and offices for engineers above, and, we believe, bachelor apartments entered into some of the schemes, but it has never appeared that any considerable amounts of money were subscribed, nor did it appear clearly in whose hands the title of the property should be vested, nor who should be responsible for its control and management. Naturally capitalists were not over-eager to subscribe to a scheme with so slight a foundation and a superstructure designed on such inadequate business principles.

The Mechanical Engineers' Library is under the control of a separate association, called the Mechanical Engineers' Library Association, the "affairs" of which, it is said in the constitution, "shall be managed by a board of nine trustees." Three of these are elected "at the first annual meeting"—presumably of the Engineers' Association, although it is is not said so in the Library Association's printed by-laws. The title to the building at No. 12 West Thirty-first Street, New York, occupied by the library and the society, is vested in the trustees of the Library Association. While this organization may be the basis for the formation of a really good library in the future, it must be admitted that at present it is not giving any very great manifestations of activity or vitality, and the prospects which it holds out for the formation of such a collection of books as engineers need is not very promising. In the mean while, the need of such a library increases day by day, and it would be one of the greatest aids to the advancement of engineering art and science that could be provided.

It will be a great waste of money and of effort if the mechanical, the civil, the electrical, and the mining engineers should each attempt to form libraries of their own. Not only many of the books, but most of the expenses of their care would be duplicated if separate libraries are maintained. Although the effort to establish a joint engineering library which was made some years ago—as has been said, died of inanition and of talk—the scheme seems to be a very practicable one, and might be carried out if a little sound business knowledge was exercised in carrying it out. Of course there is the question of where the money is to come from; but this ought to be a secondary one, in order of consideration, for the reason that before money can be obtained there must be assurance that whatever is contributed will be wisely expended. There is now so much wealth in the hands of persons who have acquired it through some of the engineering occupations that it seems certain that if it could be clearly shown that whatever was contributed for the formation and maintenance of an engineering library would be wisely expended, and would accomplish the purposes for which such a library should be formed, that there would be comparatively little difficulty in securing liberal contributions by bequest and otherwise. Men who have acquired wealth and have kept it usually have at least that kind of hard sense which would recoil from seeing, or knowing, or even suspecting that if it was devoted to any purpose it would be misused or wasted. The first requirement to unloose the purse-strings of rich people is to give them the assurance that the money, if given for the purposes for which it is asked, will be wisely employed. Therefore, before it is possible to be successful in the solicitation of money for establishing and maintaining an engineering library, some organization is needed which will provide adequate responsibility for its care and expenditure and for the conduct of the library.

In the organization of the Mechanical Engineers' Library Association such a plan is outlined. As already explained, it is provided in its by-laws that its affairs shall be managed by a board of nine trustees, to be elected by the Mechanical Engineers' Society. Now, supposing that the word "mechanical" was omitted from the title, making the organization the Engineers' Library Association, and each of the societies named above were invited to appoint, say, five library trustees, who jointly should form a board of management of a library association. It is probable that better men would be selected if these were appointed by the respective presidents, with the approval of the boards of managers or the council, than would be the case if they were elective. Such an organization would have the authority and responsibility of their respective societies back of them, which would prevent the appointment of unworthy persons, or, at any rate, if by mischance bad appointments were made, the influence of the respective societies would speedily cause such appointees to be supplanted.

Thus organized, and with such authority and responsibility, the board could devise and formulate a plan for a library, and, it may be, could make feasible the scheme of a building for the joint occupancy of the different societies, with the library as the main central feature. All this could be done without money. They could then go before the public and say, "This is our scheme; we want the money to carry it out, and we will be responsible for the conduct of the enterprise. While we are not immortal, it is presumed that our societies are; and when we fall by the way, our creators will see that competent substitutes will be appointed to fill our places."

It should be kept in mind, too, that the mere collection of books and making them accessible to readers is only a part of the purpose which a library should fulfil. To serve its purpose fully it should be completely indexed, not only by the titles and authors of books, but topically. The extent to which this may be carried, and its usefulness, is still very imperfectly understood. The accumulations of periodical literature are now almost useless on account of their enormous volume. A thorough search through such publications is now entirely impossible for busy people, and nearly so for students who devote all their time to such work. Such literature is now growing at an increasingly rapid rate. A library, therefore, should have as an adjunct an indexing department which would do much more than catalogue the books. Already considerable work has been done in this direction, and if collected together would be of very great value. Indexing has the great advantage, too, that its value is not dependent on its completeness alone. An index to one number of THE AMERICAN ENGINEER has its use; if carried over a whole year it is twelve times as valuable; and if it covered the whole period of its issue, the same proportionate increase would accrue. The indexing of the volumes of one periodical would be valuable; a hundred or more would be in like ratio.

Now, what more creditable and satisfactory monument could one or more of our millionaires create for himself or themselves than to endow an engineering library? A building, which ought to be a work of art, would be erected in some conspicuous place, with every modern appliance for the care of books and for facilitating their use and study. Two meeting halls would be provided—one large and one small one—arranged so that hearing would be easy and discussion a pleasure—facilities afforded by very few halls. These would be

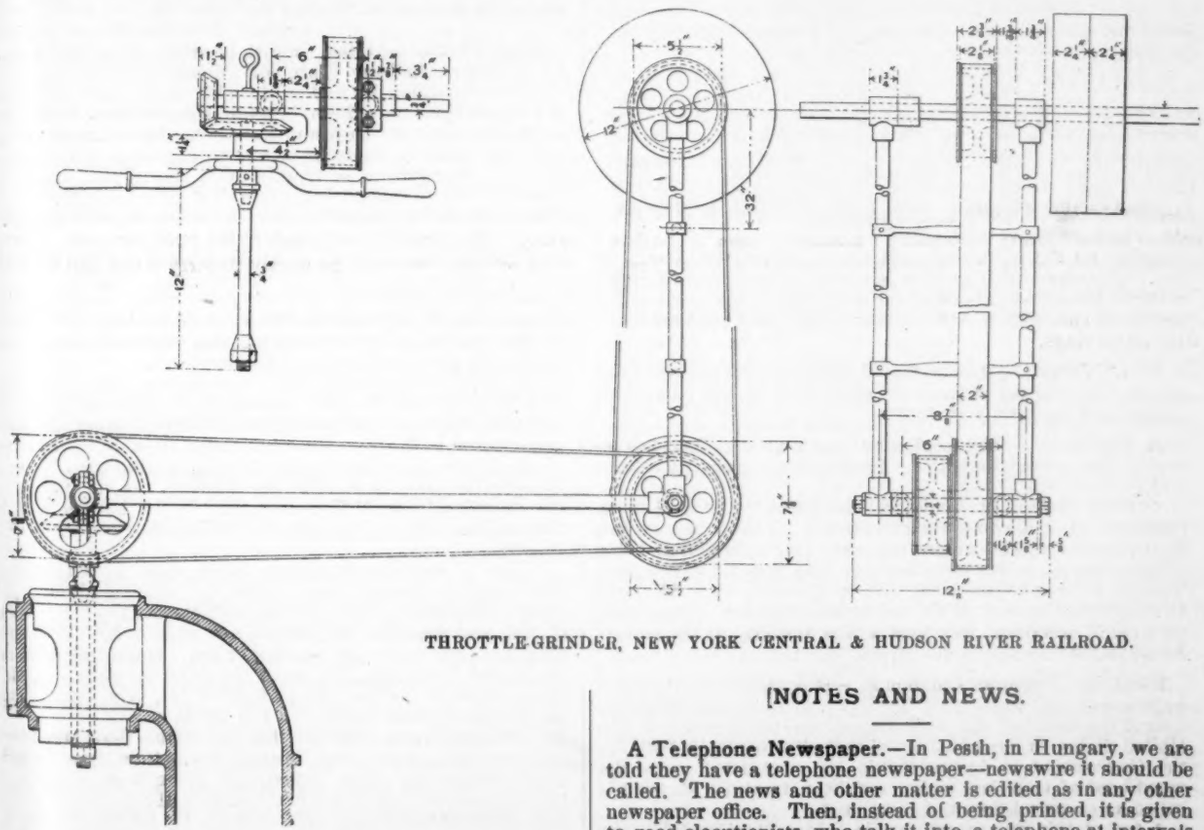
provided, too, with all needed apparatus for scientific exposition and experimental demonstration. Apartments would be provided for each of the societies named, and possibly others, and the building would contain offices for engineers, which would all yield a revenue for the support of the library. It would be possible to combine with the library an engineering museum, in which would gradually be stored specimens of all kinds, of interest to those engaged in "the art of directing the great sources of power in nature for the use and convenience of man." Such a place would be quite sure to become a centre of engineering science, art and business. An appeal is made to those who are able and inclined to devote some of their surplus wealth to a very useful purpose, and who, in doing so, could establish an enduring monument to their intelligence and beneficence.

AUTOMATIC STABILITY.

To the Editor of the AMERICAN ENGINEER AND RAILROAD JOURNAL:

SIR: I read with interest Mr. Moy's letter in the June number on longitudinal stability, but cannot agree with his statement that "a mechanical bicyclist is an impossibility." One of the requirements of a good cycle nowadays is that it ride "hands off." This is accepted as a proof of superior steering qualities, although such is not necessarily the case, for some fine steerings are not "hands-off" stereers; but given a machine properly designed to make it a good "hands-off" steerer, and it will steer itself in a substantially straight line over a uniform surface till the speed dies down. It will do this whether it carries a rider or not, so it is simply a statement of fact to say that a mechanical bicyclist is a possibility, and, further, it is already an accomplished fact. It is known by most of the older riders that a "hands-off" steerer if left to steer itself will make a straighter line than if the rider attempts to steer it. Fancy riders often ride toward a handkerchief at speed, dismount backward, allowing the wheel to continue its course, pick up the handkerchief, and then follow and overtake the cycle before its speed dies or its course changes. To test the steering of a cycle, I have stood at one side of a yard, with a friend at the other side, and we have bowled the cycle back and forth between us. If this is not mechanical steering, what is? Mechanical steering is not of much value except on uniform surfaces, and I fear that it will be valueless in the air, because of the irregularity of many of the currents. The undulation and pulsation of the air current will require movement of the machine to adapt itself to the best conditions, and self-steering will not do this. In calm air or in a perfectly steady current it would serve all right, but this is where it is least needed. In cycling, beginners make no use of the self-steering feature of their cycles, because they cannot sit steadily enough. Their every motion interferes with the self-steering tendency of the machine, and it may be thus with the machine in the air. It seems most likely that it will be necessary for the aviator to take advantage of the wind continually, and to do this he must continually balance, as does the bird. Practice will make this easy, just as it has made cycling, skating, stilt-walking, and swimming possible and easy. It probably will be possible to make machines of such size and power that they will go ahead regardless of such things as wind gusts, much as our ocean steamers do to-day; but it is far more likely that success will be found in the small individual machine, where the man is a part of the craft, and where every variation of direction of air current is noted and either compensated for or made use of by the aviator.

CHARLES E. DURYEA.



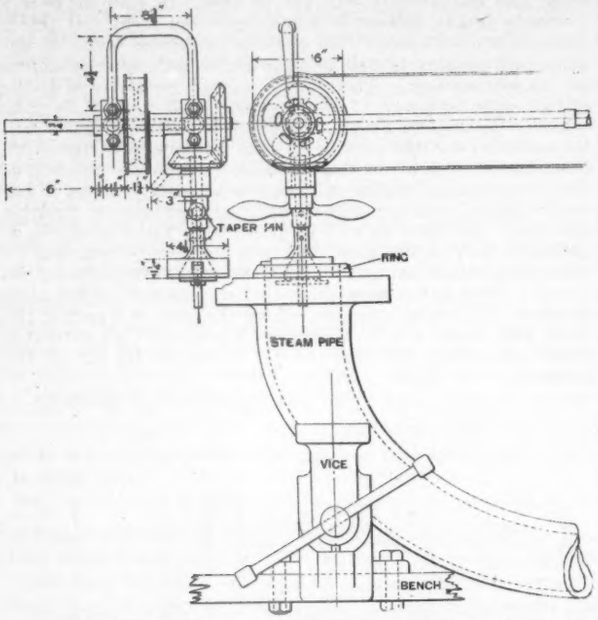
THROTTLE-GRINDER, NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

NOTES AND NEWS.

A Telephone Newspaper.—In Pesth, in Hungary, we are told they have a telephone newspaper—newswire it should be called. The news and other matter is edited as in any other newspaper office. Then, instead of being printed, it is given to good elocutionists, who talk it into a telephone at intervals during the day and evening. The receivers are connected to the main line by long, flexible wires, so that the hearer can listen in bed or wherever suits his or her will or fancy. Twenty-eight editions are uttered per day. In the intervals the recipients are entertained by music from vocal and instrumental concerts which are specially given in the office, and the wires are also connected with the opera house and music halls, and on Sundays and saints' days with the churches. The happy Hungarian, it is said, can lie abed all day and yet hear everything that is going on.

Throttle and Steam-Pipe Grinders.—In the West Albany shops of the New York Central & Hudson River Railroad there are two machines in use for grinding throttle-valves and steam-pipe joints that are exceedingly rapid and efficient workers. The construction of these machines is very clearly shown in the accompanying engravings. Both grinders are made in the same way, with a slight change in dimensions and details. The throttle-grinder, which is shown in full, con-

sists of a 1-in. counter-shaft with a tight and loose pulley, from which a swinging arm is suspended, that, in turn, is connected to a horizontal arm upon the further end of which is a pair of bevel gears driving a vertical shaft, to the lower end of which the valve is fastened. A cross-handle serves to give the operator perfect control of the movements of the apparatus, and a ring above the shafting affords a means of



STEAM-PIPE GRINDER, NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

hanging up the horizontal arm when the machine is not in use. The steam-pipe grinder is made in the same way, with a slight difference in the method of mounting the gears at the operating end, which will be readily seen by a comparison of the engravings.

The "Vzryv."—One of the Russian torpedo-boats has the above consonantial name. To pronounce it you inhale red pepper and stand on your head.

A Big Cable.—The Lexington Avenue Cable Road has recently been opened for traffic. Its cable arrived shortly before, and the *Sun* says:

"It was made in St. Louis, and cost $30,000. It is 1½ in. in diameter. It came on three giant spools. The longest section is five miles long and weighs 68½ tons. It is said that no cable of equal length in one piece has ever been brought to this city. The other two sections bring the total weight up to 128 tons. It took 52 horses and 25 drivers to transport the largest spool on a truck weighing five tons across the city to the power-house in East Twenty-sixth Street.

Electrical Fireproof Compound.—It is reported in the daily papers that the Secretary of the Navy, upon the recommendation of the Board of Naval Engineers and Constructors of the United States, ordered on July 24 that all war vessels built for the Government in future should be constructed as to the wood used of materials which had been treated with what is called an electrical fireproof compound.

A test of this was recently made before Mr. Constable, the Building Superintendent in New York. Two model wooden staircases were built, one treated with the new compound, which was injected into the wood, and the other was not. After being set on fire the untreated one was speedily burned up, while the other was not.

The Latest Record.—The work of smashing the world's record for long railroad runs goes on apace, and it is now held by the Lake Shore & Michigan Southern Railway. On the morning of Thursday, October 24, a train left One Hundredth Street, Chicago, at 3.29:27 and arrived at Buffalo Creek 11.30:34. The distance travelled was 510.1 miles, and the time elapsed was 481 minutes 7 seconds, making an average speed of 63.60 miles an hour. Five stops were made, and the time lost thereby was 10 minutes and 57 seconds, so that the time actually consumed in running the 510.1 miles was 470 minutes 10 seconds, or an average speed of 65.07 miles an hour. There were 24 slow downs for railroad crossings and 14 for other purposes. Eight-wheeled engines were used throughout the run except between Erie, Pa., and Buffalo, N. Y., where a 10-wheeler was employed. The details of the run are as follows:

The train left Chicago at 3.29:27, and made the run to Elkhart, 87.4 miles, in 85 minutes 26 seconds, an average speed of 61.32 miles an hour. There was a heavy white frost on the rails, rendering the run somewhat difficult. At Elkhart 2 minutes and 11 seconds were spent in changing engines, and the train left there at 4.57:04 for Toledo, arriving at the latter place, a distance of 133.4 miles, at 7.01:39, an average speed of 63.60 miles an hour. The time lost in changing engines here was 2 minutes and 36 seconds, and the train left Toledo at 7.04:07 for Cleveland, a distance of 107.8 miles. This run was made at an average speed of 60.96 miles an hour, the train arriving at Cleveland at 8.50:13. Only 1 minute and 45 seconds was lost here in changing engines, and at 8.51:58 the train started on the run of 95.5 miles to Erie, the distance being covered in 85 minutes and 32 seconds, an average speed of 67.01 miles an hour.

On arriving at Buffalo a portion of the party took the Empire State Express for New York. This train left Buffalo at 12.55 P.M. and reached New York at 10.15, after a total elapsed time since starting from Chicago of 17 hours, 45 minutes. The members of the party were met at the Grand Central Depot and driven to several places of amusement in the evening, and the Chicago morning papers were received on the day of publication for the first time. The total distance run was 980 miles, and the through time, including all stops and delays, was equal to about 56.16 miles per hour.

Draft Sheets.—At the August meeting of the Southern & Southwestern Railway Club, Mr. Michael reported on some experiments which he had made with draft sheets or smoke-box diaphragms on a 20-in. × 24-in. consolidation locomotive on the Memphis & Charleston Railroad. By a careful adjustment and use of pyrometers and vacuum gauges, it was found that the arrangement of double draft sheets, like that illustrated by the accompanying engraving, gave far better results than could be obtained with the ordinary single diaphragms. All of the "readings for each sheet were taken, as near as they possibly could be, under the same relative conditions, the engine having the same throttle opening, working in the same notch in quadrant, with the same steam pressure and at the same mile post, the tests being made on July 24 and July 26, the weather in both tests being hot, clear, and dry, and on an average grade of 70 ft. to the mile.

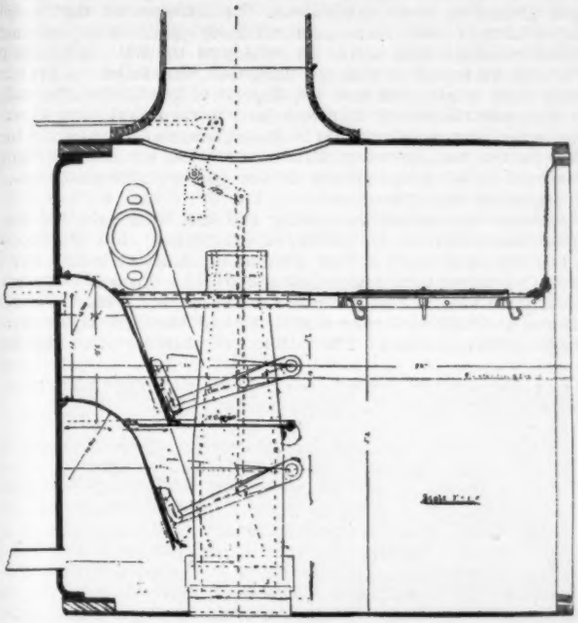
"Twelve readings were taken in each test. The 12 readings with the double draft sheet developing a temperature of 381° in the top chamber and 401° in the bottom chamber, the average vacuum in the top chamber being 2.23 in. of water in the glass, or 0.10 lbs. vacuum; in the bottom chamber 1.75 in. of water in the glass, or 0.07875 lbs. vacuum, the vacuum in the top chamber being 21.5 greater than in the bottom, and the temperature being 3.9 greater in the bottom chamber than in the top.

"Twelve readings were also taken with the single draft sheet now commonly used, under the same conditions precisely, developing a temperature opposite the top row of flues of 364°, and opposite the bottom row of flues 348°, or 4.4 per cent. greater heat at the top flues; the vacuum opposite the top row of flues being 2.15 in. of water in the glass, or .09675 lbs., and at the bottom 1.85, or 0.08325 lbs. of vacuum, being 14 per cent. greater vacuum at the top flues.

"This proves conclusively that the double draft sheet gave 13.2 per cent. greater heat through the bottom flues than the single draft sheet. The temperature being much lower with the single sheet, which I think has been the cause of the bottom flues giving us so much trouble by leaking. Making comparisons between the two sheets, you will find that the average temperature of the double draft sheet at the top is 385°, and the average temperature with the single draft sheet at the top is 364°, a difference of 21°, or 5.4 per cent. greater heat in favor of the double sheet, while the average temperature of the double draft sheet at the bottom is 401°, and that of the single sheet at the bottom is 348°, a difference of 53°, or 13.2 per cent. in favor of the double draft sheet. The average vacuum of the single sheet opposite the bottom row of flues being 1.85 in. of water in the glass, while with the double sheet it is 1.75, a difference of 0.10, or 4.4 per cent. less vacuum opposite the bottom row with the double sheet.

"It will be noticed that the temperature of the gases passing out of the flues where the two sheets are used is much hotter than with the single sheet, and with particular reference to the bottom flues to the reduced temperature in the same caused by the gases passing through the flues without being consumed, and in the case of bottom flues stopping up the tendency of fuel in them to be drawn through the bottom flues

is very materially reduced by the application of the second sheet. It is also seen that engines equipped with two sheets are saving fuel over those using the single, and this is particularly noticeable in the case of four 17 × 24-in. passenger engines running on the Memphis & Charleston Railroad, all equipped with the double sheet, alongside the same class of engines equipped with the single sheet, where a saving of coal is shown with an increased size nozzle."



DOUBLE DRAFT SHEETS, MEMPHIS & CHARLESTON RAILROAD.

The report states that the actual percentage of coal saving is as yet unknown, but the committee is of the opinion that adjustable draft sheets are certainly an important factor in economical consumption of fuel, in decrease of repairs due to leaks of flues, in cleansing of flues and consequent better steaming, and also that the cost of introduction of such an element of economy is infinitesimal when considered with the results obtained.

The New Battleships.—In our issue for September we published a brief notice of the new battleships for which bids are asked by the Government. Since the publication of that notice the Navy Department has given out more complete information regarding these vessels, the details of which we reproduce from the *Army and Navy Journal:*

"The general dimensions of the Department design on load-water line at normal displacement of 11,500 tons are: Length, 368 ft.; moulded breadth, 72 ft.; mean draft, 23 ft. 6 in.; total coal capacity, loose stowage, 1,210 tons; coal carried at normal displacement, 410 tons. It is contemplated to drive the vessel by twin screws. The engines are to be of the vertical triple-expansion type, two in number, in two separate compartments. The five boilers to be of the cylindrical double-ended pattern, three in number, and two single ended boilers to be placed in four compartments. Any alternate design of machinery submitted by contractors must fulfil the general requirements contained in the 'Specifications to be followed by Contractors for Machinery' issued by the Bureau of Steam Engineering.

"If, on trial, the average speed shall equal or exceed a speed at sea of 16 knots per hour for four consecutive hours, the vessel will be accepted in so far as the speed is concerned. If the speed falls below 16 knots and exceeds 15 knots per hour, the vessel will be accepted at a reduced price, the reduction being at the rate of $100,000 per knot speed below 16 knots. If the speed falls below 15 knots per hour, the vessel will, in the discretion of the Secretary of the Navy, be rejected or accepted at a reduced price mutually agreed upon between the Secretary and the contractors. In case of rejection any money that may have been paid to the contractors on account shall be refunded. The time that will be allowed for the construction of these vessels will be three years from the date of signing the contract. The hull is to be of steel, not sheathed, with double bottom and close water-tight subdivisions. There will be two military masts with fighting tops, to carry no sails.

"There will be a side-armor belt 15 in. thick with a mean depth of 7 ft. 6 in., extending at least from the stem to the after barbette, and to maintain this maximum thickness throughout the engine and boiler spaces; from thence forward it may be tapered gradually to a thickness of 4 in. The transverse armor at the after end of the belt, and just forward of the boilers, will be not less than 8 in. thick. Barbettes for 13-in. guns will have armor not less than 15 in. thick, except in rear, where it will be reduced to 12 in. The turret port plates to be 17 in.; the balance of the armor-plating 15 in. thick. The ship's sides from the armor belt to the main deck will be protected by not less than 5 in. of steel armor from barbette to barbette. Coal is to be carried back of a portion of this 5-in. casemate armor. An armored deck is to extend throughout the length of the vessel, not less than 2½ in., but with slopes 3 in. thick. A cellulose belt is to be fitted along the sides the whole length of the ship. A conning tower of not less than 10 in. in thickness, having an armored communication tube not less than 7 in. in thickness, will be carried in a suitable commanding position, the tube extending to the armor deck and affording protection to voice tubes, bell wires, etc. The 8-in. gun turrets will be superposed on the 13-in. turrets, and the armor will be not less than 11 in. in thickness on the port plates and 9 in. elsewhere. In wake of the 5-in. guns on the main deck is to be continuous armor 6 in. thick extending between the turrets. Further protection is to be afforded by splinter bulkheads between the guns, 2 in. thick, extending from deck to deck. Protection is to be afforded the smaller guns by shields and extra side-plating.

"The total coal-bunker capacity must not be less than 1,210 tons, stowed in bunkers without trimming by hand, of which at least 410 tons are to be carried at normal displacement. The electric-lighting plant should consist of three units, each dynamo having a rated output of 400 ampères at 80 volts. The total weight of the three units complete should not exceed 31,500 lbs., and the total weight of the whole electric installation 44 tons. The battery of the vessel is to be four 13-in. breech-loading rifles, four 8-in. breech-loading rifles, fourteen 5-in. rapid-fire guns, twenty 6-pdr. rapid-fire guns, four 1-pdr. rapid-fire guns, four machine guns, one field gun. The supply of ammunition is to be as follows: Two hundred rounds 13-in. ammunition, 500 rounds 8-in. ammunition, 3,500 rounds 5-in. ammunition, 10,000 rounds 6-pdr. ammunition, 2,400 rounds 1-pdr. ammunition."

The "Nashville" and the "Wilmington."—These two vessels have been recently launched at the yards of the Newport News Shipbuilding Company. The *Nashville* is a light-draft twin-screw gunboat designed for the usual duties of cruising naval vessels. In coast work her moderate draft of water will enable her to enter many ports from which most men-of-war are excluded on account of their greater draft. She is 220 ft. long on the water-line, with 38 ft. beam. At her normal draft of 11 ft. her displacement is 1,371 tons. She is schooner-rigged, with two smoke-stacks, and her total coal-bunker capacity is 390 tons. She has two types of boilers, cylindrical and water-tubular. She will be able to cruise without recoaling for long periods at moderate speed, using her cylindrical boilers only, being able rapidly to increase her speed to its extreme limit by starting fires under her remaining boilers. No attempt has been made to secure over 14 or 15 knots a hour, that being sufficient for the duties required of such a vessel. The engines driving the twin screws are of the quadruple-expansion type, so designed that the low-pressure cylinder can be disconnected when the vessel is cruising under ordinary circumstances. When running at full speed the high-pressure cylinders receive steam from the Yarrow boilers directly, while the two cylindrical boilers supply steam to the receivers between the high and first intermediate cylinders. At moderate speed, the low-pressure cylinders being disconnected, steam can be supplied to the two triple-expansion engines so formed by either of the batteries of boilers. The main battery consists of eight 4-in. breech-loading rapid-fire guns, four of them being on the upper deck; two 1-pdr. rapid-fire guns and two Gatling guns. One fixed torpedo tube is mounted in the bow, and a searchlight is placed just above the pilot-house and forward of the foremast.

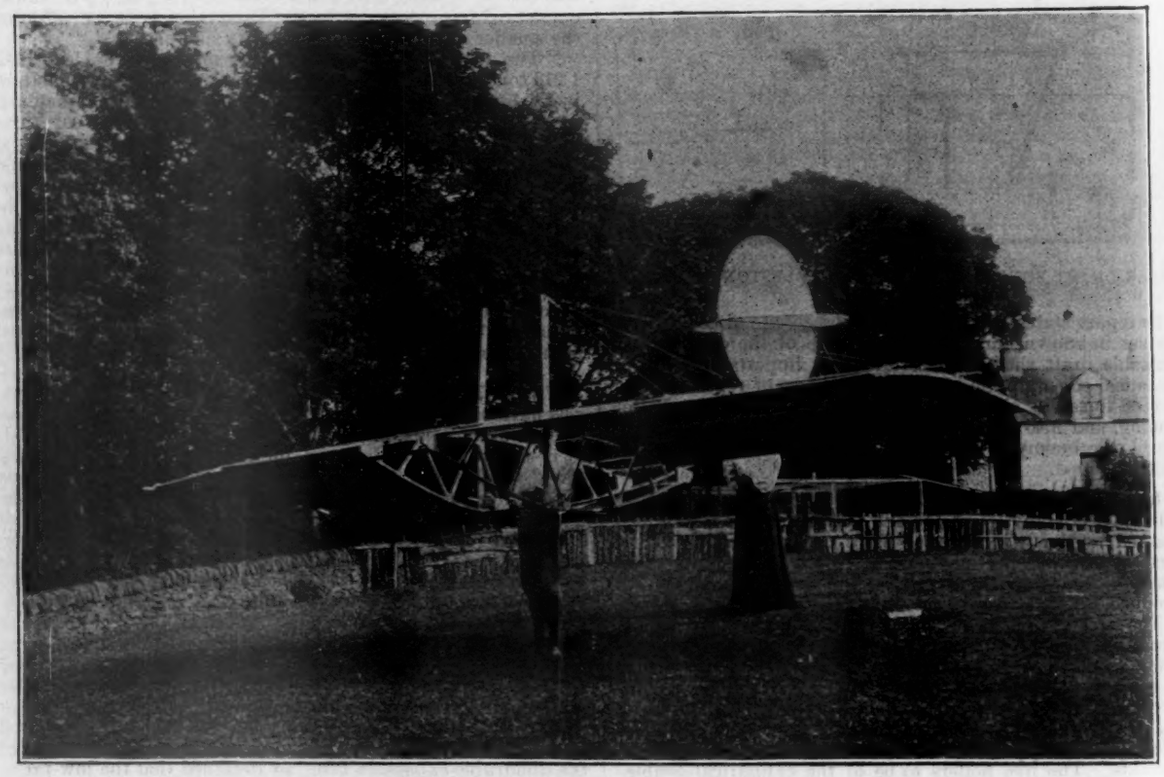
The *Wilmington* has been built for entirely different service. Although in every respect a perfectly safe seagoing vessel, the *Wilmington* and her sister ship, the *Helena*, whose launch will not take place for several weeks, are designed especially for river service. In external appearance the *Wilmington* resembles a small battleship, having a large military mast with two military tops, similar in all respects to the one on the battleship *Iowa*, which serves to command the banks of a river or houses in a town where she may have to prevent rioting. A conning tower on the mast, just below the first

military top, enables the ship to be manœuvred at a height of 45 ft. above the water-line. The space available for quarters is large, and affords berthing capacity for many additional men besides her crew. To facilitate landing a large body of men she has boats of an unusual size, her steam cutter and sailing launch being each 33 ft. in length, or as long as those supplied to the heaviest battleships. The machinery consists of triple expansion twin-screw engines. The total coal-bunker capacity is about 280 tons. Two rudders are provided, one ahead of the other, so arranged that it may be possible to run the vessel into a bank and let her swing around with the current when turning in narrow channels. Her battery is the same as that of the *Nashville*, and she has a searchlight on her military mast, but no torpedo tubes.

In the launching of these ships there was a peculiarity deserving of especial mention. It is, we believe, the first case where two warships were launched on the same day from a single set of ways. The vessels had been constructed one ahead of the other, tandem fashion, upon a continuous decline, the *Nashville* nearer the water, with her bow a few feet from the *Wilmington*, both vessels taking the water stern foremost. This arrangement was due to the fact that the works of the contractors, in accordance with modern notions, had been installed for the erection of ships of the largest size, the building slips being of sufficient length to accommodate a vessel 500 ft. long, while the combined length of the *Nashville* and *Wilmington* is only 485 ft. 3½ in. Not only was ample space available for both ships, but it was also possible to deliver in position all the material used in their construction by a single crane, which travelled alongside on a track 80 ft. above the ground. This great crane, with a lifting capacity of 60,000 lbs. at the end of its 125-ft. arm, also served an adjoining similar slip, from which the steamer *Newport News* was recently launched. The *Nashville* had to travel only 250 ft. before floating freely, but the *Wilmington's* sternpost had 280 ft. to slide before reaching the water and 175 yds. altogether before she was fully floated, the constructors having estimated that in this descent she would attain a velocity of 11 knots an hour, which is nearly equal to her best steaming speed. On account of this unusual trip for a ship to make out of her element, special precautions had been taken in the construction of her supporting cradle to obviate any derangement while in motion. Under the *Nashville* the sliding ways were 157 ft. long, 19 in. broad, and 15 in. thick, while under the *Wilmington*, the thickness remaining the same, the breadth was increased to 25½ in. and the length to 176 ft.

ELECTRICITY AT THE PARIS EXPOSITION OF 1900.

In a recent issue of the *Proceedings of the Society of Civil Engineers of France*, M. G. Dumont gives a *résumé* of what was done in the way of electric lighting and power transmission at the Paris Exposition of 1889, at Chicago in 1893, and at Lyons in 1894. Basing their operations upon the experience gained at these exhibitions, the directors of the Paris Exposition of 1900 have outlined their plans in a bulletin issued a short time ago. In reference to this matter, M. Dumont says that it appears then, that, thanks to the precedents thus established and the degree of perfection attained in the construction of dynamos and motors, that it is absolutely the proper thing to do to have recourse to electricity in 1900 for the complete organization of a service that shall include the lighting and distribution of power to the exhibitors. In a general way it is understood that this double service will include several central generating stations, which shall themselves be exhibitions of boilers, steam-engines, and dynamos. Some will be devoted to the production of a continuous current, and others to the alternating current. From these generating stations the conductors are to run out either underground or overhead for the distribution of the necessary lighting or power current. The public will thus be in a position to arrive at the exact value of the different systems that are in use.



PILCHER'S FLYING MACHINE, FRONT VIEW.

It is expected that the total amount of power required in 1900 for these several systems will be about 8,000 H.P. for motors and 12,000 H.P. for lighting. It is further expected that in the evening the stations will be called upon to supply the full quota of light and about one-quarter of the motors that are installed.

Adopting the ratio of efficiency of 70 per cent., as given by the Lyons installation, for the power absorbed by the motors, the mechanical power required for the work will be 8,000 ÷ .70 = 11,400 H.P. for the distribution of power instead of the 5,500 H.P. used for this purpose in 1889; and 12,000 ÷ .70 = 17,100 H.P. for the lighting circuits instead of the 4,000 H.P. required in 1889 to light one-quarter only of the area of the exposition grounds. This gives a total of 28,500 H.P. that will be required if all of the lamps and motors are working together.

Practically (unless accumulators are used) the machines ought to furnish 11,400 H.P. to the motors during the day,

and in the evening, from seven o'clock till midnight, 2,900 H.P. to the motors and 17,100 to the lamps, or a total of 20,000 H.P.

In this case it is proposed that the generating plants should consist of 40 units of 500 H.P. each, of which one-half shall be at rest during the day, thus leaving a machine at rest on exhibition by the side of its duplicate which is in motion. By the use of accumulators it would be possible to install a smaller number of units which would develop their full power from early morning until the closing of the gates, say from about nine o'clock until midnight. Under these circumstances the engines would supply the power required for driving the motors and charging the accumulators between the hours of nine and seven; while in the evening the engines and accumulators would supply the 20,000 H.P. indicated.

A calculation of the expense of installation of the two systems has shown them to be about the same, but with a slight difference in favor of the use of accumulators; but if accumulators are useful in a plant containing only a small number of motors, because the power is very irregular, they will hardly be justified in an exposition which will include a large number of motors, each representing only a very small percentage of the total power. Furthermore, the consumption of coal will be less if engines are exclusively used, since 11,400 H.P. will have to be furnished during the day for 10 hours, and 20,000 during the evening for five hours, making a total of 214,000 H.P. hours; while with the accumulators 225,000 H.P. hours will be required.

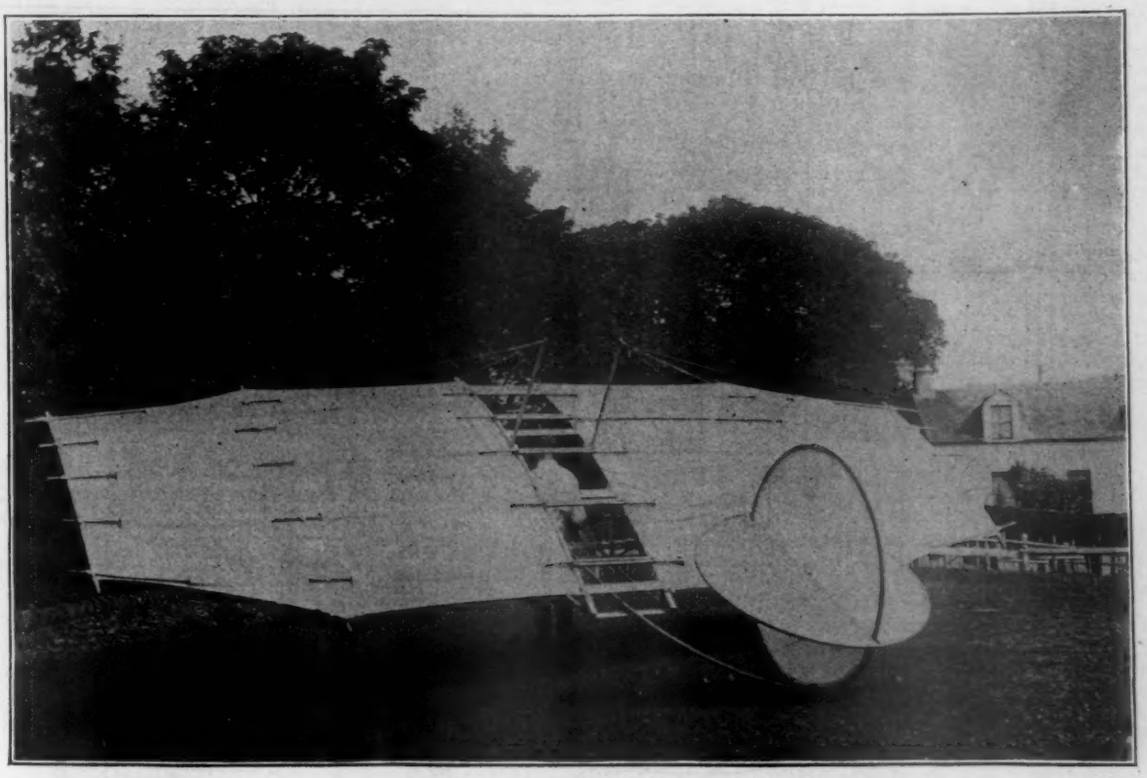
But if it is finally decided that it is not advisable to use accumulators in the production of the energy required in the general system of distribution, they will be valuable for exhibitors who can charge batteries by connecting them to the main lines leading to the lamps and motors. They can then be discharged at will by the exhibitor, for whom they will constitute a sort of reservoir of electricity. It will be with the aid of these accumulators that will form, as it were, substations, that experiments of the greatest interest can be made in view of the visitors, showing the various uses to which accumulators can be put, the method of charging and discharging, making connections, etc., and at the same time permitting them to ascertain the space required and the method of installation for each type.

We have already said that the central electric stations will be made interesting exhibits of boilers, steam-engines, gas-engines, etc. The value of these exhibits will be increased by the fact that it will be possible to make a comparison of the conditions of installation, running efficiency of engines, and gas-engines.

It is, therefore, expected that the central stations will be equipped by exhibitors, and that they will furnish the current required to the exposition; that the management of the exposition will construct the system of wiring for the distribution of the current; that the electricity thus made available will be sold to the contractors who assume the responsibility of distributing it to individual exhibitors for lighting and to supply the lamps used for general illumination; that the location and wiring of the motors required by the exhibitors will be undertaken by the contractors, who will have the concession for supplying the current needed by the exhibitors for the operation of their motors.

PILCHER'S FLYING MACHINE.

In our August number we published engravings on pp. 386 and 387 of Mr. P. S. Pilcher's first soaring machine. The tips of the wings, as first constructed, formed a diedral angle, and were about 4 ft. above the body piece when the machine was horizontal. Since the publication of these views it has been altered, and the tips of the wings are now only about 6 in. above.



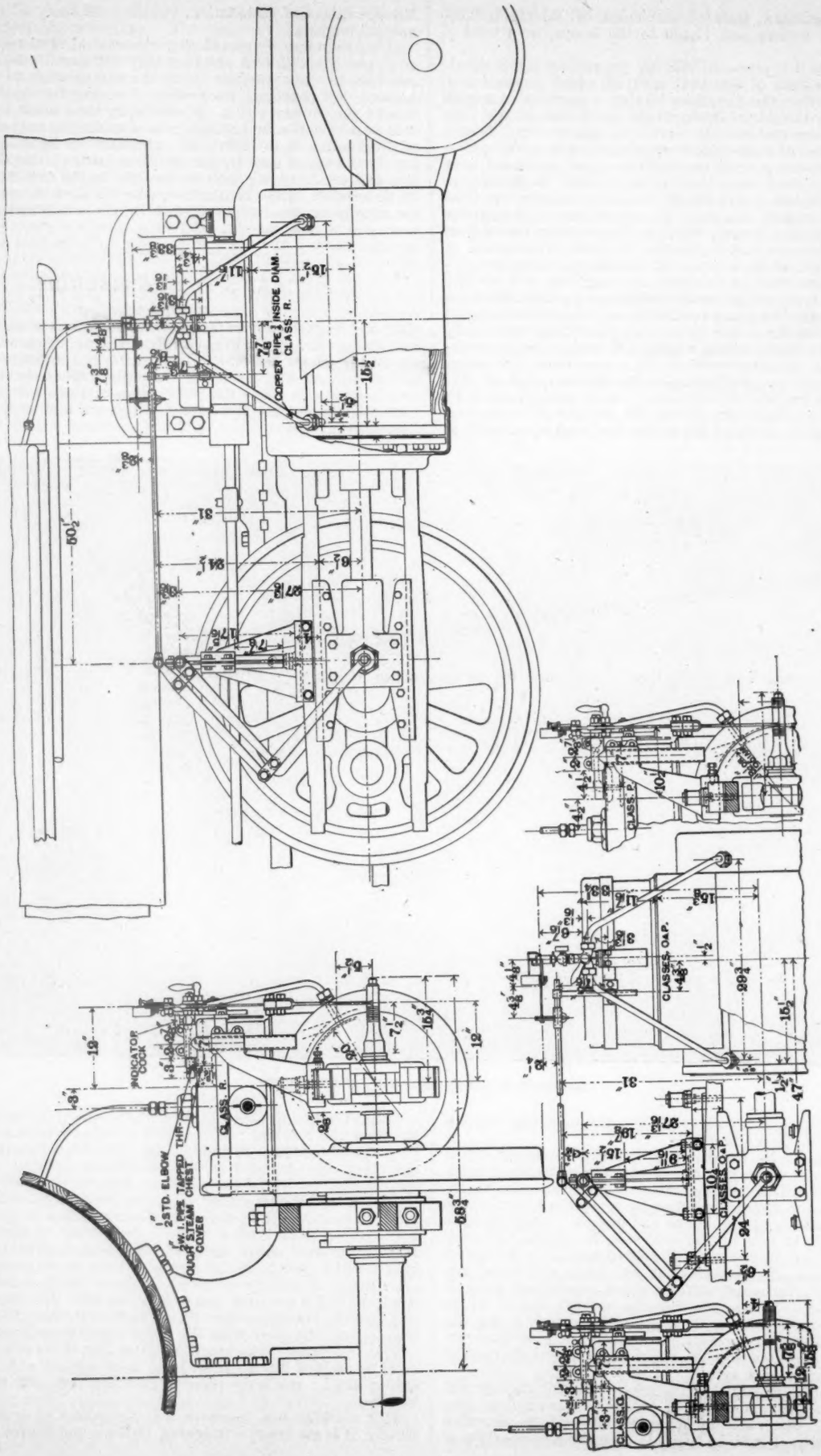
PILCHER'S FLYING MACHINE, REAR VIEW.

This alteration has made a vast improvement in the ease of handling the machine; a side puff of wind has now only a very slight tendency to incline the machine, whereas before the wings were lowered it was exceedingly difficult to keep the machine upright if the wind was not exactly ahead.

As a result of this alteration it has been possible to make trials in heavier winds, and consequently better flights have been made. Mr. Pilcher was on September 12 picked up from the ground, taken up 12 ft., and landed after spending nearly half a minute in the air; and later on the same day—after the wind had gone down a little—a line was tied on to the front of the machine, and a man ran with this; the result was that the machine, with Mr. Pilcher in it, went 20 ft. into the air, and was away from the ground nearly a minute.

The two engravings herewith show Mr. Pilcher's second machine, which has about 170 sq. ft of surface and is of a strong build; the body piece is of white pine and the ribs bamboo.

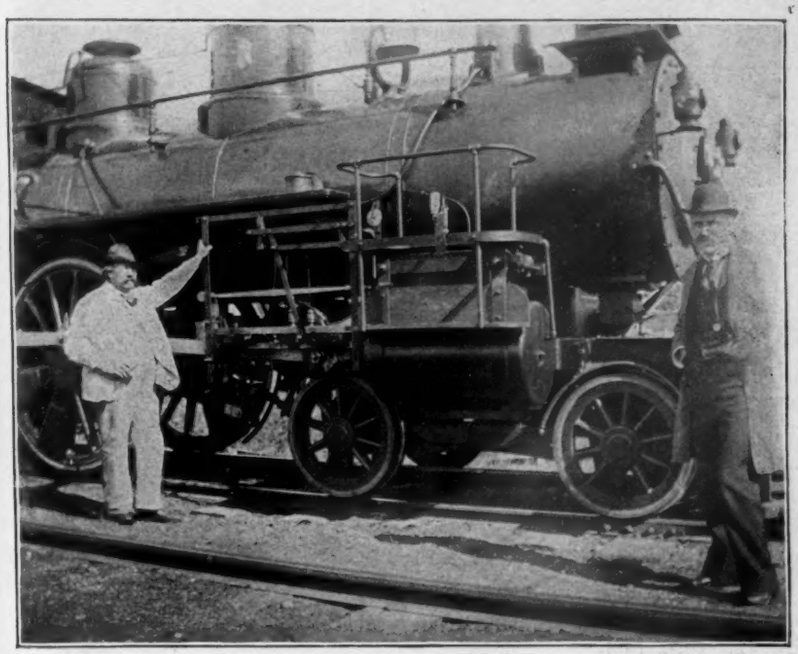
This machine has, however, two impediments against it: Firstly, it is too heavy—weighing 80 lbs.—and it tires out the



INDICATOR RIGGING IN USE ON THE PENNSYLVANIA RAILROAD, APPLIED TO CLASS O, P AND R LOCOMOTIVES.

experimenter very soon ; secondly, the sails are too high with reference to the operator, which, although having the advantage of keeping the wing tips farther off from the ground, makes the machine very difficult to handle.

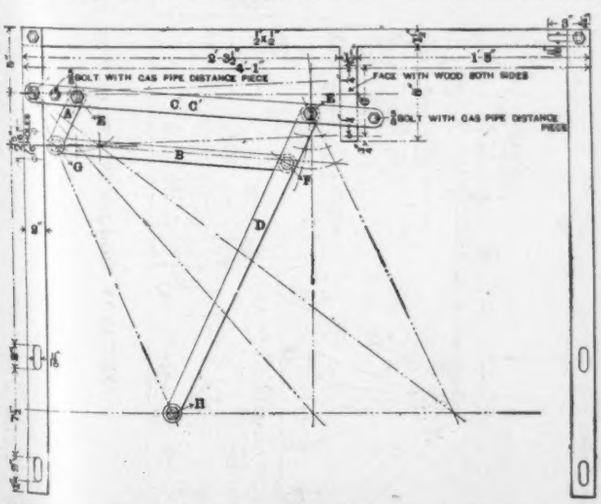
Mr. Pilcher is now making a third machine for trials on very still days, with a sail area of 300 sq. ft. and a very light structure.



INDICATOR RIGGING APPLIED TO A LOCOMOTIVE ON THE FLINT & PÈRE MARQUETTE RAILROAD.

INDICATOR RIGGING FOR LOCOMOTIVES.

We illustrate two arrangements of indicator rigging for locomotives that are successfully used upon the Pennsylvania and the Flint & Père Marquette Railroads respectively. They are of the same type, and differ merely in the arrangement of some of the details and the dimensions. From the half-tone reproduction of the photograph, which was taken from one of



INDICATOR RIGGING USED ON THE FLINT & PÈRE MARQUETTE RAILROAD.

the Flint & Père Marquette locomotives, and the detail drawing of the apparatus it will be seen that it is made for application to an engine with four bar guides and is somewhat less expensive to make than that used on the Pennsylvania engines. The supports are merely 2 in. × ¼ in. bars of iron fastened with two ⅝-in. bolts and a strap to the ends of the guides. This has ample strength for the strains that are put upon it, but it seems as though there would be considerable vibration at the upper ends when the engine is running at high speeds. This would be obviated by the arrangement in use upon the Pennsylvania engines, where a cast stand is bolted to the upper guide, and is of such shape and weight as to avoid vibration. It is more expensive to make, however, and cannot be as readily adapted to various types of guides.

The photograph of the Flint & Père Marquette locomotive shows the convenient arrangement of bracket for the operator that is used. A careful examination will show that the whole rigging can be lifted off by merely taking out the bolts that pass through the front bar and the strap running along the inside of the steam-chest. Where an elaborate series of tests are to be made at high speeds and extending over a long time, it is desirable that there should be a hood or fender at the front to protect the operator from the wind, but where the indicator is to be used merely to study the action of the valves and the steam distribution at different points of cut-off and speeds, this portable device is just the thing to use. It is light, almost universally applicable, and can be put in position by the operator without assistance. The railing and uprights are of gas pipe, and the other parts of light flat iron.

The engraving of the Pennsylvania rigging shows it applied to one of the standard class R locomotives of the company with two-bar guides. A single three-way cock is used for admitting steam from either end of the cylinder to the indicator, and the pipes leading thereto are made as short as possible, it having been found that there is no appreciable advantage in accuracy gained by the use of two indicators placed near the ends of the cylinders, while the inconvenience of manipulating two instruments and the extra attachments that must be made is a nuisance.

The dimensions are given with such completeness on both of the detail engravings that any one can very readily reproduce them for his own use, and a recapitulation of them is therefore unnecessary.

A FLY-WHEEL ACCIDENT IN HOBOKEN.

At about half-past three on the morning of Saturday, October 5, a fly-wheel 17 ft. in diameter, in the plant of the Hudson Electric Light Company, in Hoboken, N. J., burst, killing one man instantly, and injuring two others. The wheel belonged to a 500 H.P. vertical compound engine that was built by the Philadelphia Corliss Engine Company. The cause of the accident is supposed to have been the racing of the engines, as they began to do this just before the accident. At the time the engineer was on the upper platform, closing the throttle, and in a direct line with the motion of the wheel.

The accompanying engraving shows the construction of the wheel in all of its details. It will be seen to have been built up and composed of eight spokes bolted in between flanges that formed a portion of the hub, and at the outer ends these spokes were bolted by four 1¼-in. bolts to the centres of the segments forming the rim. These segments were 52 in. wide and about 6 ft. long, and were bolted together at faced flanges by eight 1¼-in. bolts. The flanges of the hub were 2¼ in. and 3 in. thick, and stood 6 in. apart between their inside faces. The wheel was entirely broken up, and the pieces were thrown out in a line with its working position to a distance ranging from a few feet up to 150 ft. All of the fractures appeared to be clean breaks through metal that was apparently sound except for an occasional blowhole. The normal speed of the engine was 100 revolutions per minute. The inner ends of the spokes were held to the flanges of the hub by three 1¼-in. bolts to each spoke ; the spokes, however, were not in contact with each other, there being a space of about ¼ in. between them.

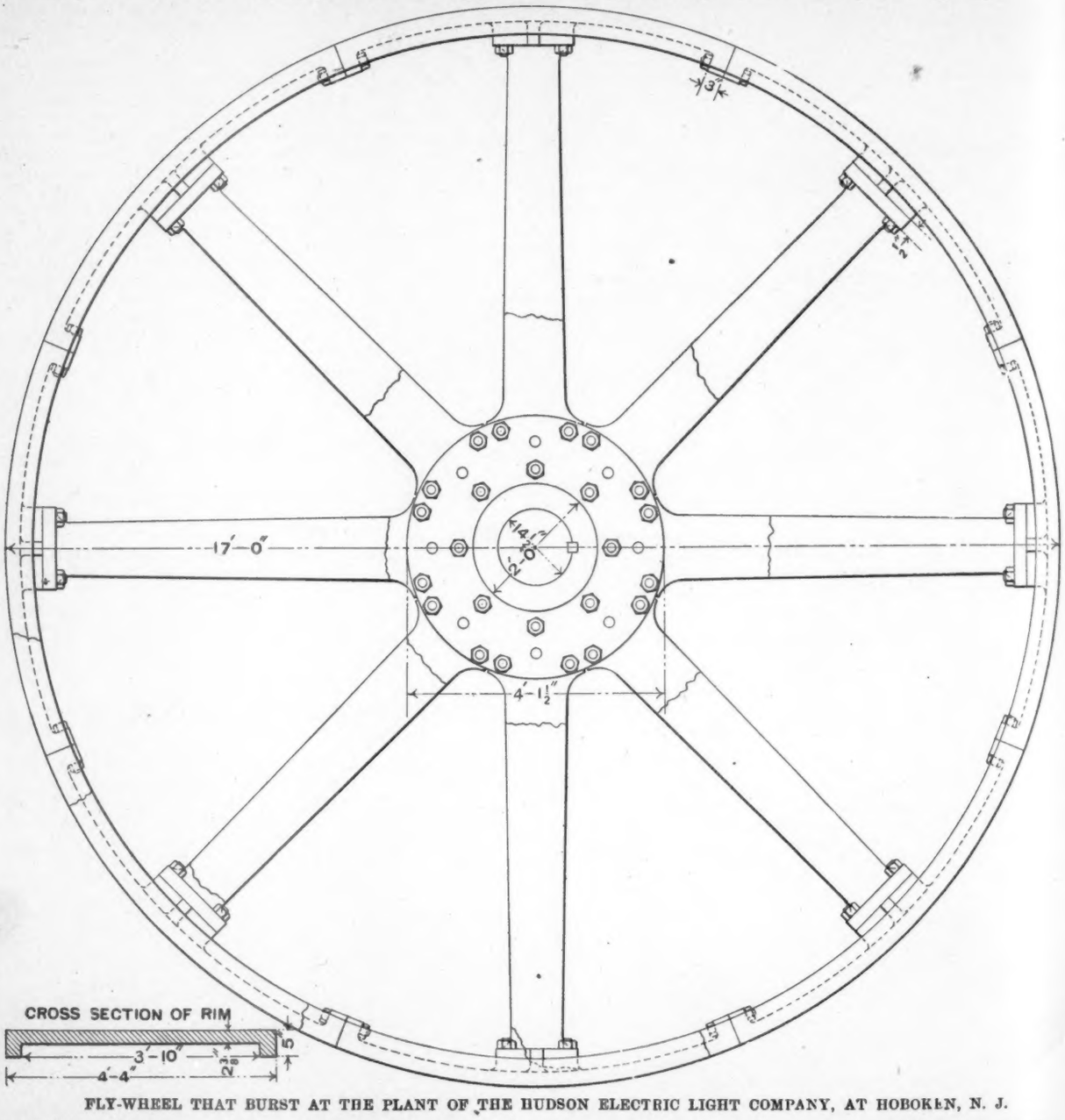
As we have said, the accident is attributed to the extra strains set up in the metal by the racing ; but if this is the case, it would seem that the wheel was running very close to its limit of safety.

The normal speed that was used would produce a circumferential velocity of 5,340 ft. per minute, and this would re-

sult in a centrifugal force of about 29 to 1, giving an actual strain on the metal of about 2,760 lbs. per square inch of section—a strain that certainly is not excessive, and is so far below the elastic limit of metal that should be used, that the break cannot have been caused by bad designing and abnormal strains due to excessive velocity. It would seem, then, that the metal must have been intrinsically weak, notwithstanding the clean, close-grained appearance of the fracture. This is given merely as a conjecture to explain the cause of the accident, and without any definite data regarding the actual quality of the metal that was used. The breaks shown are a few of those that occurred in approximate positions only.

Let an overloaded motor work irregularly; let a condenser choke up or empty while starting or stopping; let the resistances be ever so variable, and we will see the ropes oscillating, storing up, by their elasticity, the variations of speed or effort, while the receiving lines of shafting do not vary in the regularity of their motion; provided, of course, that the variations of power and resistance are not too great.

This peculiarity has been of great service in very many cases, especially in transmissions that are driven by gearing and by rigid shafting whose motion cannot be regulated.



FLY-WHEEL THAT BURST AT THE PLANT OF THE HUDSON ELECTRIC LIGHT COMPANY, AT HOBOKEN, N. J.

ROPE AND BELT TRANSMISSION.*

By V. Dubreuil.

The striking feature in the use of ropes is the uniformity of motion, the absence of noise, even at the fastenings, when the ropes are well maintained, and the sensitiveness of all of the strands the moment anything abnormal occurs in the power or the resistance.

Ropes are also of great service where the two lines of shafting to be connected are not perfectly parallel. We can then open the grooves, work the strands crossed, and carry the power off in almost any direction.

Diameter of Pulleys and Ropes.—The resistance due to the stiffness of the ropes being represented by the formula $R = .104 \frac{a\,d^2}{D}$, in which R is expressed in pounds; a, the tension on the rope, in pounds; d and D, the diameters of the rope and pulley respectively, in inches. From this we see that D increases in proportion as d and R are less.

Linear Velocity.—In rope transmissions, the linear velocity per second should not be less than 26 ft. per second, or more than 82 ft. For belting, this speed may drop as low as 10 ft.

* Abstract of a paper read before the Society of the Civil Engineers of France.

by increasing the breadth proportionately; but it is best not to have the speed exceed 65 ft. Above 65 ft. for belts and 82 ft. for ropes the centrifugal force, which up to this point is unfavorable to the adherence of the belts and favorable, on the other hand, to that of the ropes, now becomes unfavorable to both.

Distance between Pulleys.—On account of the coefficient of friction, which is 25 per cent. greater in the case of ropes than of belts, as we shall show later on, ropes work best when slack and belts when under a tension. Consequently long distances are more favorable to ropes than to belts, the weight of the rope in the case being a factor that is favorable in assisting to free it from the grooves. Hence these distances may vary from 20 ft. to 100 ft. for ropes without an intermediate support, and from 13 ft. to 50 ft. for belts. In my own practice I have set up a rope transmission with a span of 328 ft. and only one intermediate support; others of 16 ft. that have been running since 1877, and still others of only 11½ ft.; but these are very exceptional.

Position of the Slack and Tight Strands.—Contrary to the usual opinion, I consider that it is preferable in most cases, and when it is possible, to place the driving strand of the rope on top, in order to utilize the good effects of the centrifugal force and also the weight of the rope to assist in lessening the amount of power absorbed. Nevertheless, when the distance between the centres of the pulleys is less than 23 ft. or 26 ft., and again when the ratio between the diameters of the pulleys is less that 1 to 3, it is better to place the driving strand at the bottom if it is possible to do so. In some tests made by the Industrial Society of the North of France, the driving strands of the cables were placed above; the ratio of the pulleys was as 3 to 10 for 160 H.P. developed at the piston; the diameter of the ropes was 1¼ in., and the slipping did not exceed 0.329 of 1 per cent., while it varied from .78 to .964 of 1 per cent. with belts.

Ratio of Pulleys.—Under no circumstances should the diameter of the smallest pulley be less than 30 times the diameter of the cable, and it is well not to drop below 1 to 4 for the ratio between the diameters of the pulleys.

Kind of Ropes.—Ropes should be of three-stranded Manilla hemp or of cotton. Manilla seems to be preferred in Ireland, while cotton is given first choice in Manchester. Hemp is much cheaper than cotton, and, in most cases, is more durable, instances being known to me where it has run for more than 10 years in industrial establishments; but while cotton is the more expensive, it is the more pliable.

Diameter of Ropes.—The diameter of the ropes varies with the nature of the installation and the diameters of the pulleys. The large ropes of from 1¼ in. to 2 in. in diameter have the advantage of requiring a smaller number of elements than the smaller; but as the small ropes can work under a strain per square inch almost double that of the large, it sometimes happens that it does not need more small ropes for an installation of reasonable dimensions than it would of the large. So that this matter of size is largely one of convenience.

Number of Ropes.—The number of ropes varies with the material used, its diameter, and the strain which the rope can be made to carry per square inch of section. It also varies with the nature of the industry. Thus, for a given H.P. developed, only one-third as many ropes are required for driving a woollen carding or combing-room as for a cotton spinning-mule with a self-acting frame.

Sectional Area of Ropes.—In a rope it is necessary to make a distinction between the apparent and the actual diameter. In practice I have followed this rule:

$$S = \frac{\pi D^2}{4} \times 0.65,$$

S being the sum of the cross sections of the three strands and D the apparent diameter of the rope.

The Wear of Cables at Work.—It is necessary to pay attention to the stretch and wear of cables while they are in use. This stretch, which lessens the diameter, depends upon many things: the nature of the material, the care exercised in manufacturing, work of the rope, etc. Thus it is well to order ropes with a diameter of from 12 to 15 per cent. greater than their useful diameter.

Pulleys.—The pulleys should be perfectly balanced upon ways and not upon centres. The grooves should be exactly alike, as well as the corresponding diameters of the two pulleys that are next each other. Each groove should be cleared of metal, so that the rim may be as light as possible, and not create, by the multiplication of these pulleys, a sum total of active energy that may, at a given time, especially when the motor is being stopped or started, neutralize the action of the fly-wheel and cause accidents.

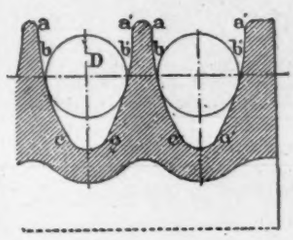
In general, pulleys with grooves of from 1¼ in. to 2 in. should not exceed a weight of 5½ lbs per inch of diameter of pulley per groove. Thus, for a pulley 80 in. in diameter and having four grooves, we have $80 \times 5.5 \times 4 = 1760$ lbs. This rule varies for pulleys of from three to six grooves, and for ropes of from 1¼ in. to 2 in., and is also modified in other cases. Thus, for a single-groove pulley for 1¼ in. to 2-in. ropes, the weight will rup up to 11 lbs. per inch of diameter instead of 5½ lbs.; for a two-groove pulley it may be from 7 lbs. to 8 lbs.; for an eight-groove pulley with single arms it may be 4¼ lbs. For ropes of smaller diameter, the results just given should be multiplied by from .65 to .85, according to circumstances.

It will be seen that these rules are entirely empirical, and their only object is to render it possible for the engineer or proprietor to make some calculation in advance as to the results upon which he can rely.

Shafting and Bearings.—All works on mechanics give formulæ for calculating shafting and hangers. These formulæ do not take sufficiently into account the enormous tensions which are produced when new ropes are put into position or when they are wet, so that it is necessary to increase these coefficients. It should be borne in mind that the diameter of a shaft carrying a grooved pulley must never be made less than from 3 in. to 3½ in., for the mere fact of the presence of this pulley, is a warning, were it only called upon to transmit a hundredth of a H.P.

Form of Grooves.—The diameter of the cable fixes the dimensions of the groove, but the shape should be in accordance with the following rule:

The section is composed of two vertical, parallel, or oblique portions, *a b*, *a' b'*, connecting with two curved portions, *b c*, *b' c'*, ending in straight lines that are inclined to each other at angles of from 38° to 48°, according to the use that is to be made of the grooves, and finally of an arc of a circle connecting the two curves *b c* and *b' c'*.



GROOVES FOR ROPE PULLEYS.

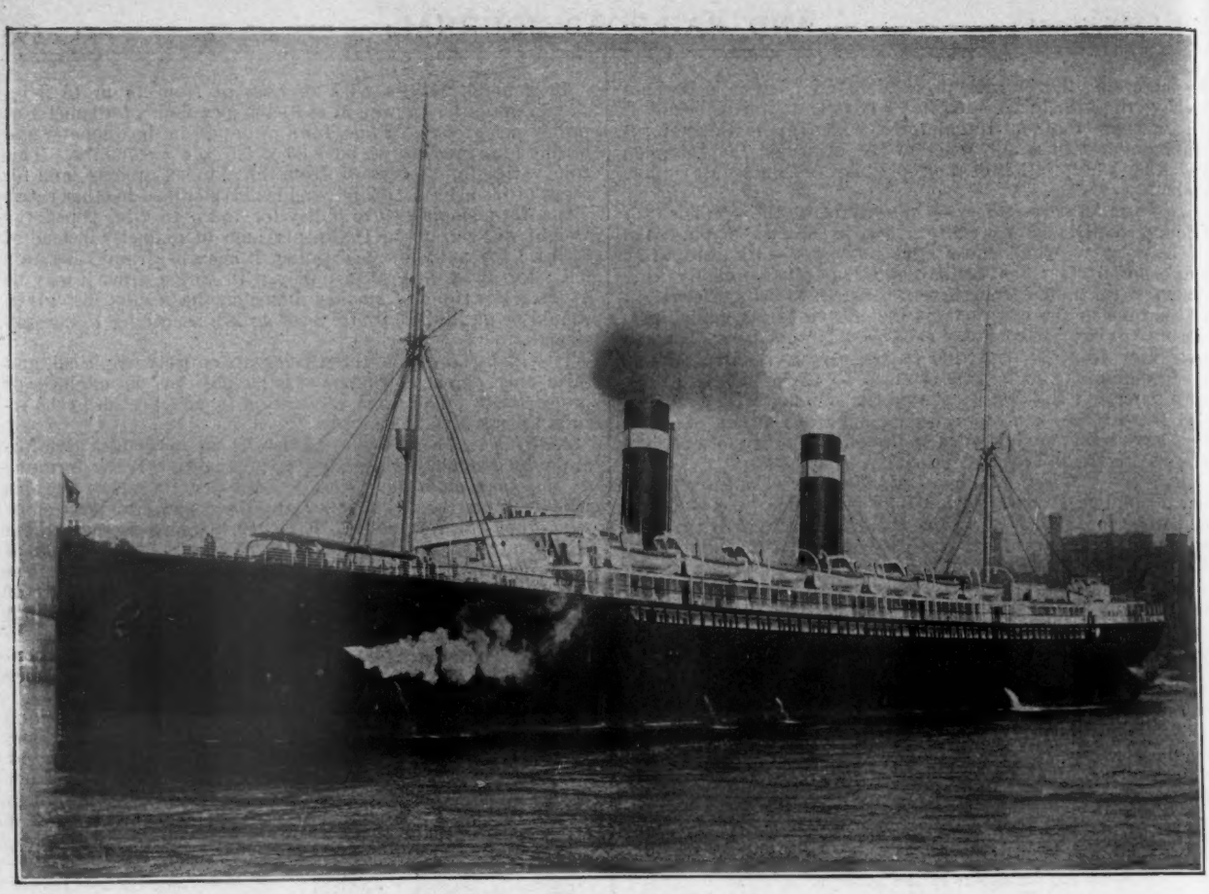
An angle of from 45° to 48°, which gives the lowest coefficient of friction, is well adapted for use with horizontal ropes; one of from 42° to 44° for ropes that are more or less inclined, an angle of 43° being best adapted for inclinations of 45°, and one of from 38° to 41° for ropes rising from 50° to 90°.

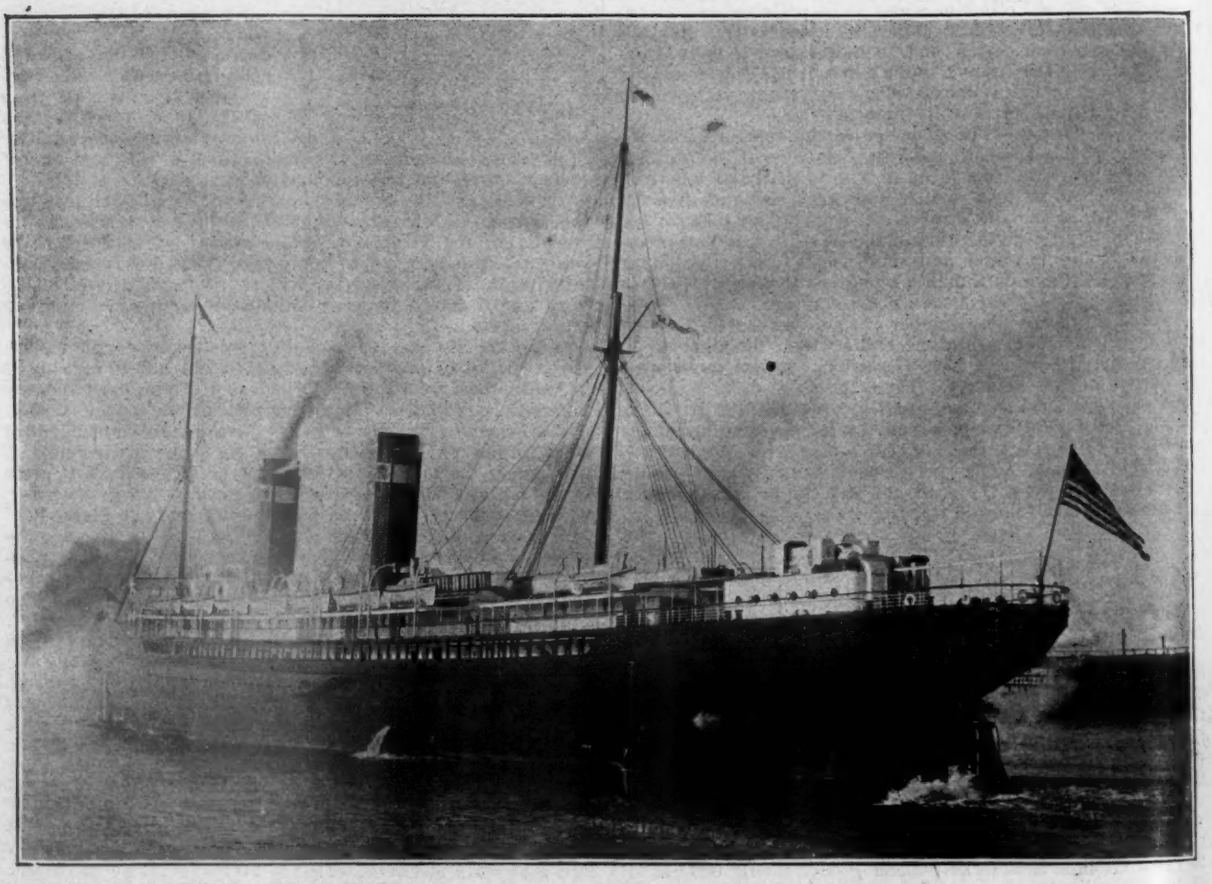
Theoretically the ropes should never be allowed to touch the bottom of the groove; they ought in service to be wedged in the V portion of the groove, so as never to be subjected to a slipping of more than .35 of 1 per cent. Disintegration of the filaments will result from a greater slipping, and it is apt to occur both at the starting and stopping of the ropes.

Oiling the Ropes.—It is well to grease the ropes to a moderate extent, so as to make them pliable, but not so lavishly as to cause them to slip; and this is one of the most delicate things to be attended to in the maintenance of ropes. Castor-oil used moderately once or twice a month is recommended for hemp ropes. As for cotton ropes, there are many compositions upon the market that are contending for the first place in industrial establishments. As a general thing, however, when such a rope is well used it is unnecessary to grease it.

Friction of Ropes and Belts on Pulleys.—Some time ago the Messrs. Parce Brothers, of Dundee, made a series of experiments to determine the relative frictional resistances of ropes and belts upon the pulleys over which they were run. The angle of the V of the groove in the rope pulley was made 40°, and both ropes and belts embraced one-half the circumference of their respective pulleys. The weight suspended from one end was 335.5 lbs. Taking an average of the experiments with ropes on dry pulleys, the coefficient of friction was found to be .90, while the average of the experiments with belts gave .68, a difference of .22 in favor of ropes, or 25 per cent. Some of these experiments—and they were those that gave the best results—were made with new ropes. In fact, the pulley remaining the same, we see that as the diameter of the cable diminishes it drops lower down into the groove, and the coefficient increases. The same thing occurs when the rope is at work and is subjected to varying strains: its diameter increases and diminishes in proportion to the strains that are put upon it, and consequently with the power that it is called upon to transmit.

This is an exceedingly important point, and shows how rational the system is.





Photographed by W. H. Rau, Philadelphia, Pa.

THE AMERICAN LINE STEAMER "ST. PAUL,"

MOVING DOWN THE DELAWARE RIVER ON THE WAY TO THE TRIAL TRIP.

In the experiments made with oiled pulleys, a considerable loss was made manifest.

The author then takes up the subject of the installation of rope drives, the arrangement of the framing, and gives a mathematical analysis of the work to be done, concluding with a report made by a committee appointed by the Industrial Society of the North of France. The conclusions of this committee were that, as a result of their investigations, it became evident that both ropes and belting afforded an excellent means for the transmission of power, provided that they were well designed and carefully erected. Rope transmission, however, because of the divisibility of the lines, which permits a multiple connection with the driving pulley; because of the elasticity of these lines, which are thus rendered capable of absorbing the variations of speed and power, both driving and resisting power; because of the high coefficient of friction, which allows the slack side to run very loose; and, finally, because of the low first cost—rope transmission, then, seems preferable to the use of belting. These advantages would in all cases warrant their successful application to industrial purposes.

It is very true that belts will render services equally valuable; but their high price and the requirements involved in their location are not elements that will tend to make them as popular as ropes of hemp and of cotton.

The final victory, when all builders shall be equipped, will undoubtedly belong to cables, at least until the transmission by electricity shall have been rendered more economical and practical than it is to-day—a time that may come, and in coming will place all competitors upon the same level by establishing itself in their places; but that is the secret of the future.

WATER TUBE BOILERS FOR WAR-SHIPS.

Some months ago we published very full abstracts of a discussion in Parliament and subsequent correspondence, with reference to the advisability of adopting water-tube boilers for the large new ships of the British Navy, which had been decided upon by the Admiralty. A recent number of *Engineering* contains a long letter from Mr. James Howden, of Glasgow, in which he opposes every strongly the use of such boilers. The letter is very interesting, but unfortunately we have not room for all of it, and therefore can give only a brief abstract of its most important points.

Mr. Howden says, first, that at the conclusion of the debate in Parliament it was understood that no more water-tube boilers should be ordered for the navy until their superiority over cylindrical boilers had been proved. This understanding, he says, does not appear to have been accepted by the Admiralty, as they have recently ordered engines and boilers for the new cruisers, the latter to be of the Belleville type. He now says that the Admiralty have no proof of the superiority of such boilers over those of the cylindrical type, and that the evidence which is obtainable shows their great inferiority.

He then quotes the trials of the *Sharpshooter*, which has water-tube boilers, and which were made at such a low power per unit of grate and heating surface as to be of no value as a test. Even at this low rate the consumption of coal was 1.8 lbs. to under 2 lbs. of coal per I.H.P. per hour.

In the trial of the two steamers, *Tamise* (with Belleville boilers) and *Seaford* (with cylindrical boilers)—two Newhaven and Dieppe steamers—the Belleville boilers consumed 37 tons of coal during the same period that the cylindrical boilers consumed 27. Since starting, the Belleville boilers, it is asserted, have required constant repairs, while during a year's running those in the *Seaford* required none up to the time she was lost.

The experience of Messrs. Thomas Wilson, Sons & Co., of Hull, is also quoted. They are the owners of the steamship *Ohio*, which has Belleville boilers, and is engaged in the trade between Hull and New York. "After being fully tried she left Hull on her first voyage. Before the vessel had cleared the south of Ireland, one of the boiler tubes burst and severely injured a fireman. The voyage to New York was made with considerable difficulty, owing to troubles arising in working the boilers, two at least being under repair during the voyage, which lasted 21 days, the average speed being under 7 knots."

While in New York her boilers were repaired, but her return voyage was a slow one. On returning from her second voyage to New York she was obliged to anchor in Dover Roads with boiler tubes leaking, the vessel having been 18 days out. A tug was sent from Hull as a convoy. Since the *Ohio's* trial her owners have ordered a large new steamer with cylindrical boilers.

The steamship *Unique*, on the lakes in this country, was also referred to. She was equipped with Babcock & Wilcox boilers, a 3-in. water-tube of which burst last May and killed two firemen, and blew the chief engineer, who was drowned, overboard.

Continuing, Mr. Howden says: "Whenever full power is attempted to be taken from water-tube boilers, the expenditure of coal becomes abnormal, tubes burst, and other serious damages arise, as has been shown in the case of the *Ohio* even when worked at low power continuously. Besides being at all times wasteful in fuel, the feed-water supply is always difficult to regulate. These defects, as I have said, are inherent in every water-tube boiler, *and cannot be got rid of by any modification of design*."

The writer of the letter says, further: "These vital objections, in themselves more than sufficient to prevent further use of such boilers in sea-going ships, are: 1. The much greater consumption of coal they require per unit of power compared with cylindrical boilers. 2. The greater number of stokers they require for a given power."

In conclusion he says: "If their adoption (in the British Navy) is persisted in, disaster must inevitably occur should these ships ever be so unfortunate as to engage in actual warfare, while they will be a source of continual trouble and enormous expense whenever used for cruising purposes at any effective speed. Further, such boilers will permanently cripple, as has been clearly proven, every ship into which they are fitted, independently of their other vital defects, by greatly reducing their coal endurance at their lowest speed, much more at their highest, and by requiring many more men to work them. They will likewise never be able to maintain a high continuous speed."

This abstract of Mr. Howden's letter is given because it is intended to give both sides of this important discussion. Probably the portion of his letter which is most open to criticism is the part which we have italicised. To establish that statement he will be obliged to prove a negative, which the logicians tell us is impossible. The letter, though, is an interesting contribution to the discussion, and is certain to call out reply.

THE STEAMSHIP "ST. PAUL."

In our issue for July we published an illustrated description of the American Line steamer *St. Louis* that was built by the William Cramp & Sons Ship & Engine Building Company, of Philadelphia. The sister ship, the *St. Paul*, has now been completed in accordance with the agreement with the Government made at the time when the *Paris* and *New York* were admitted to an American register. The two vessels are alike in all particulars, with the exception of a few minor details, changes in which have been made since the *St. Louis* went into commission, and which were suggested by the experience with that ship. To the casual observer the only noticeable difference between the two is in the smoke-stacks, where the cowls used on the *St. Louis* do not appear on the *St. Paul*. For a description of the steamers we would refer our readers to the one published of the *St. Louis* in our issue for July.

The engravings of the *St. Paul* on the opposite page are reproductions of photographs taken as the vessel was slowly steaming down the Delaware River on her way to the official trial off the coast of Massachusetts. The object of this trial was to comply with the terms of the agreement with the Government, by which a contract for carrying the United States mails is awarded, provided that the vessel maintain an average speed of 20 knots on a run at sea of four hours' duration. In the trial of the *St. Louis*, which was held in the English Channel, in August, the average speed was 22.2 knots. As the bottom of the *St. Paul* was foul at the time of the trial, she did not equal the speed of the *St. Louis*. The trial run was made between Cape Ann, Mass., and Cape Porpoise, Me., a distance of 41.96 nautical miles, at an average speed of 20¼ knots. The engines worked as smoothly and as easily as though they had been running for months. The run was over the course, a turn and a return over the same. On the eastward run the average number of revolutions of the screws was 89.5, and about 90 on the westward.

Immediately after the trial the vessel was taken to New York and placed in service on the line, sailing on her maiden voyage for Southampton on October 9. There was nothing noteworthy about the trip, the time from Sandy Hook Lightship to the Needles being 7 days, 12 hours, and 20 minutes, with daily runs of 394 382, 409, 412, 439, 324, 399, and 319 miles. Like the *St. Louis*, she is proving a splendid sea boat.

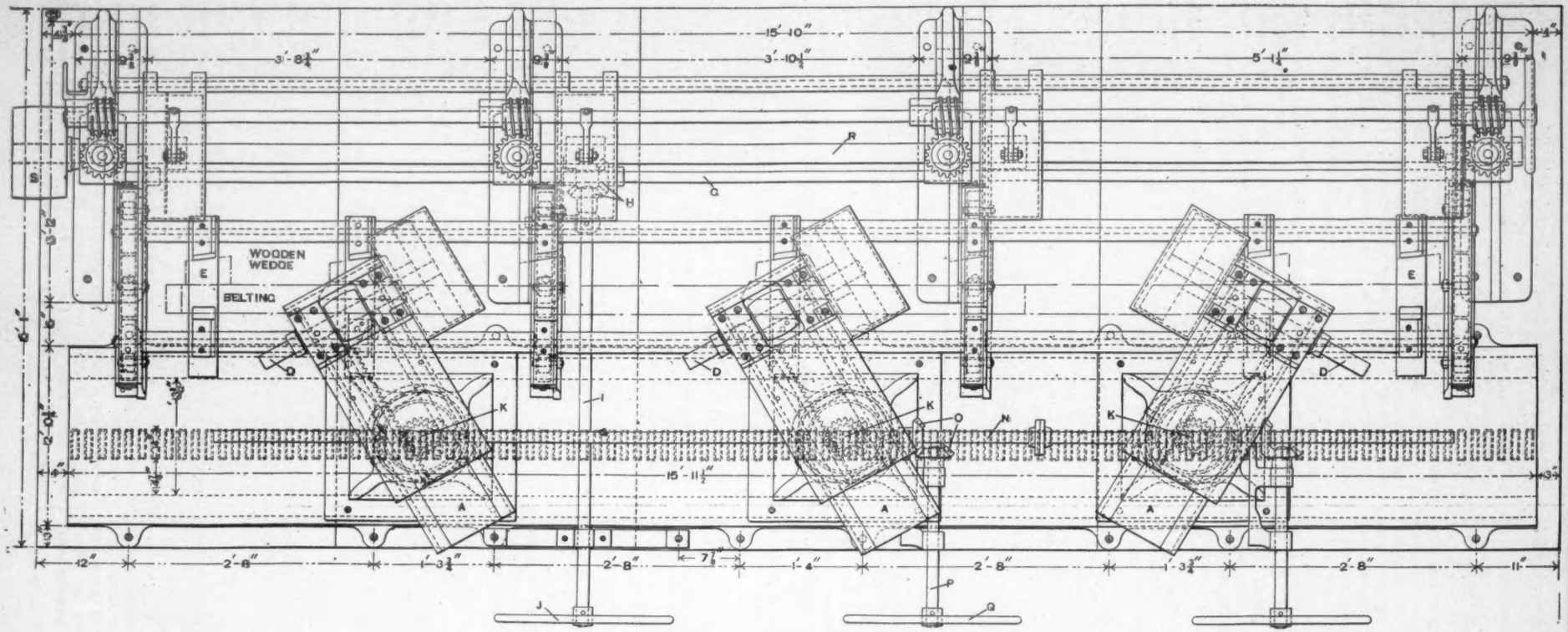


FIG. 1.—PLAN OF BELT-RAIL CHECKING MACHINE, GRAND TRUNK RAILWAY SHOPS.

BELT-RAIL CHECKING MACHINE, GRAND TRUNK RAILWAY.

IN our last issue we illustrated the standard box car of the Grand Trunk Railway, and in the course of the description alluded to a belt rail checking machine on which the checking or gaining of the belt-rails for the passage of the posts and braces is done. Through the courtesy of the officials we are now enabled to present engravings showing the construction of the machine.

There are seven cutter-heads, two of which also carry cutting-off saws for cutting the rails to the proper length. Of these three are for the diagonal gaining, are mounted on separate shafts and can be set at any angle, while the others are mounted upon a single shaft, and are for cutting gains that run at right angles to the length of the rail. For the sake of clearness as to the actual work done by the machine we illustrate a belt-rail showing in detail the work that is done.

The heads that do the diagonal checking are mounted on the carriages *A A A* that are pivoted upon the standards *B B B*, and can be set at any desired angle, according to the work that is to be done. The standards *B B B* can be adjusted longitudinally by sliding them over the base-plate to which they are held and clamped in position by means of the T-bolts, as shown in the end elevation (fig. 3). The diagonal cutters are mounted upon the shafts *D D D*, which are driven by the belts *C C C* from overhead drums. When these cutters and carriages are in position the belt-rail is clamped to the heads *E E E E E*, as shown on the side elevation (fig. 2), and the plan (fig. 1). These heads can be run forward and back by means of the gears *F* that are placed at the ends of the shaft *G*, and which mesh in with the rack on the bottom of the carriage, as seen in the end elevation. The heads and with them the belt-rail are operated by means of the hand-wheel *J*, the shaft *I*, the mitre gears *H H*, and the shaft *G*.

When the diagonal gains are cut the belt-rail is run forward to the extreme front end of the travel of its holding-heads, and the diagonal cutters run across it. These are worked simultaneously by means of the hand-wheel *Q*, the shaft *P*, the mitre gears *O*, the shaft *N* (fig. 1), the mitre gears *M* (fig. 3), and the vertical shaft carrying the pinions *K K K* that mesh in with the racks on the pivoted carriages, and thus move the cutters in and out regardless of the angle at which the heads may be set.

After the diagonal gains are cut the rail is run back, as already stated, for the cutting of the straight gains.

The cutters *T T T T* doing this portion of the work are mounted upon the shaft *R*, which is driven by a belt running over the pulley *S* at one end. These cutter-heads are susceptible of longitudinal adjustment individually, while the whole shaft can be raised and lowered, as will be presently explained. The two cutters at the ends are bolted to cross-cut saws that are adjusted to cut the rails off to the proper lengths.

Thus the work of checking these belt-rails consists in first clamping them to the heads and running these latter into the forward position; then by means of the hand-wheel *Q* the

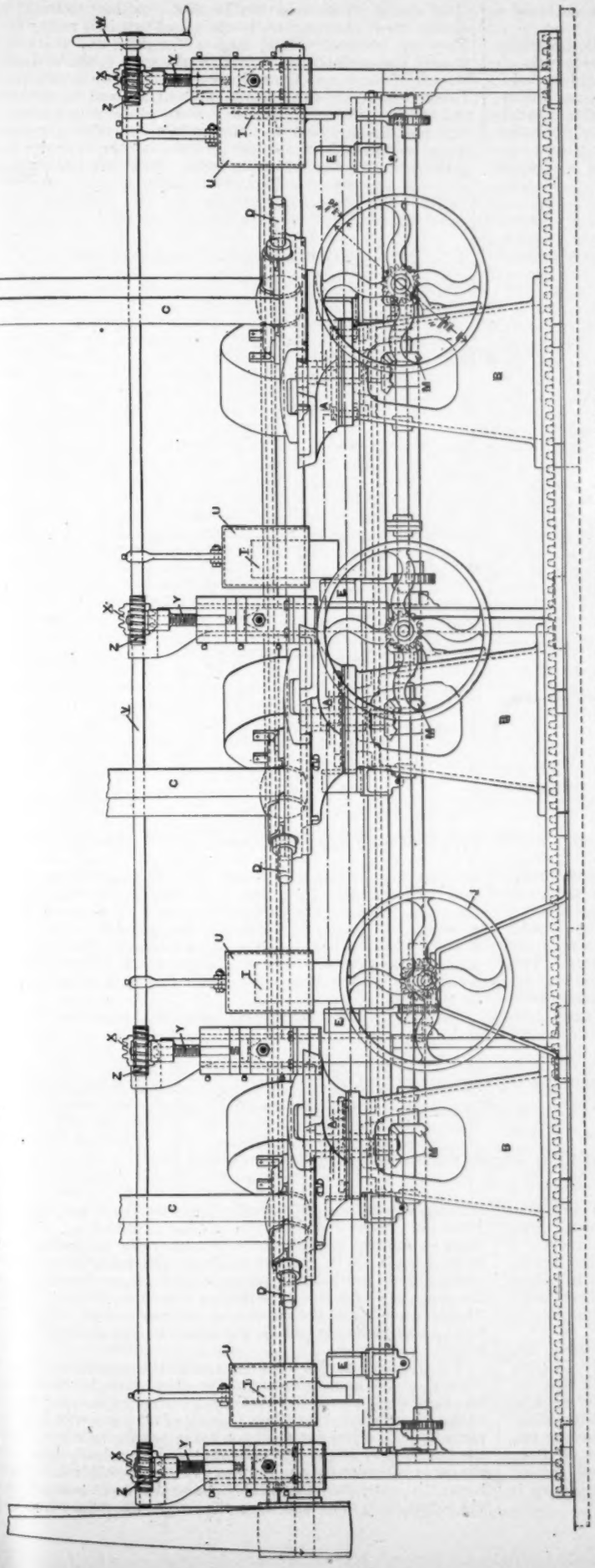


FIG. 2.—SIDE ELEVATION OF BELT-RAIL CHECKING MACHINE, GRAND TRUNK RAILWAY SHOPS.

cutters are run out and the diagonal gains cut. After they are withdrawn the belt-rail is run back beneath the straight cutters on the shaft *S* by means of the hand-wheel *J*, and there they are cut to length and the straight gains cut.

All of the cutters are protected by hoods that catch the shavings and prevent careless workmen from getting their hands mutilated by the revolving knives. The hoods *U U U U* covering the straight cutters are suspended from the shaft *V*.

The shaft *R* is raised and lowered for the adjustment of the cutters *T T T T* by means of the hand-wheel *W*, located at one end of the machine, as shown in fig. 2, and keyed to the shaft *V*. On this shaft there are four worms *X X X X* that mesh with the gears *Z Z Z Z* keyed to the vertical shafts *Y Y Y Y*, that are cut with a screw and run in nuts in the carriages that contain the bearings of the shaft *R*. These carriages will be seen from fig. 2 to be fitted to work in guides on the main bed-plate.

It will be seen from the foregoing description that the machine is adjustable in all of its working parts to meet the requirements of any piece of work that may be brought to it, provided, of course, that its size does not exceed the limits of the machine. For the special work for which it was designed, it has reduced the labor of checking to a minimum, the whole being done with two operations and without disturbing the piece from its fastenings. The machine was designed and built at the Grand Trunk shops in Montreal, because large quantities of these pieces were wanted in duplicate and there was nothing upon the market that had a capacity sufficient to meet the requirements of the case.

AMONG THE SHOPS.

H. K. PORTER & CO., OF PITTSBURGH.

IT will be no news to our readers if we remark that the past two have been years of depression in locomotive building, and the proprietors have usually had ample time to plan and execute improvements in plant and design in anticipation of the better times that we all hope are now opening before us. Among the manufacturers who have done this is the firm of H. P. Porter & Co., of Pittsburgh, who have put up new buildings and installed new tools with the double purpose in view of increasing the possible output and decreasing the cost of the same. In order to attain the latter object the milling machine has been liberally used. It is somewhat startling to learn what is being actually accomplished with these machines in comparison with that previously done on the planer. For example, it formerly required all of the time of four planers to do the work of the establishment on driving-boxes and wedges; now two milling machines attended by one man do it all in less than half the time. The rough castings are put in and finished at a single cut on Pratt & Whitney machines, and finished with an accuracy that would not be commercially practicable on a planer. In order to do this with the greatest economy and accuracy, the castings are first pickled, to remove all scale and sand, and especial attention is paid to getting a fine-grained, easily worked metal. Another example of the great advance that milling is over planing is afforded in the work done upon a certain class of cross-head, where, upon a planer, from seven to eight hours were required, and now upon the miller the cross-heads are finished at a single cut in 30 minutes, or, including the setting, 40 minutes. These are exceptional results, and are somewhat better than any we have heretofore met with, though it is usually acknowledged that

the milling machine is from three to four times as rapid a worker as the planer.

Of course, to secure the best results with the milling machine it is desirable that a great deal of work should be done in duplicate, and that especial attachments should be provided for holding and setting the same. This feature has received the especial attention of Mr. Lord, the Superintendent of the works, and there are cutters and chucks to do each piece of work that presents itself. A further advantage of providing these special appliances is found in the fact that the rigid holding of the work can be depended upon with so much certainty that the feed can be *with* the motion of the cutter instead of *against* it, without any fear of it becoming loose and being drawn in with the disastrous results to the machine or cutter or both that is sure to follow such an accident, as many know to their sorrow. The advantage of a feed with the cutter is that the strain on the gear is less, being the difference between the pull of the cutter and the friction of the parts rather than the sum of the thrust of the cutter and the friction of the parts. That this feed is safe is evidenced by the fact that on one Pratt & Whitney machine a gang chuck holds a number of rod brasses that are milled complete on the two sides and as smoothly as though they were burnished on a feed of 8 in. per minute that is never allowed to drop below 6 in. and has been raised to 9 in.

There is, however, another side to this milling question that must be considered in estimating upon the saving to be effected by them, and that is the duplicating of parts, as we have already suggested. This is one of the advantages of the shops of H. K. Porter & Co. They manufacture small locomotives; they manufacture them for the most part in stock sizes, and they keep a complete set of duplicate parts of all sizes on hand, so that it frequently happens that the filling of an order merely requires that the needed parts, such as frames, rods, and valve gear complete, be taken from stock and assembled. This necessitates absolute interchangeability of parts that can best be obtained by milling. It is of very great commercial value to a firm to be able to make prompt deliveries of extra parts for repairs, especially where the customers are the owners of only one or two locomotives, and to whom a break down means the stoppage of all work until repairs are made. A case in point may be cited where repair parts, including boiler, rods, and a number of other pieces, were ordered for an engine in Brazil, and the steamer was to sail in a week. Everything was ready, was taken from stock, shipped at once, caught the steamer, much to the satisfaction of the buyer.

Another tool that is serving as a great saver is a turret machine. It simply does the work of five lathes. It is hardly necessary to enlarge upon this brief statement except that, besides enabling one man to do the work of five in the machine shop, it has taken some work out of the blacksmith shop. When all work was done on the lathe, pins with heads or collars were forged to save turning; now they are cut off from the bar that is fed into the machine, as the turret will cut off surplus metal for less money than the blacksmith can draw it out.

Of course, every shop has its own peculiar practices; and among those current here is the use of cast-iron rocker arms. They are universally used upon all engines, and there is no trouble about breakage. Whether the same could be made to be true of large and heavy locomotives is open to discussion. These rockers are turned over the bearings and on the bosses and are then ground to a finish. Some of us who are not so very old can recollect the time when the milling machine began to supersede the slotter for finishing the irregular faces at the hubs and ends of rocker arms. Now, after the milling machine has driven the planer and the shaper from fields that were formerly their own, it is compelled to retire before the plain, common, every-day grindstone. Of course it is not accuracy but beauty of finish that the grindstone gives, but it gives what is wanted, and no more is asked. This grinding is applied to a large variety of objects where polish and not accuracy is desired, even where as much as $\frac{1}{8}$ in. of metal is to be removed.

Cast iron is also extensively used for the smaller sizes of driving-wheels, and in others where steel tires are used the latter are pressed and riveted on instead of shrinking. This is done in mining locomotives, where they are frequently sent down a shaft 500 ft. or more in depth and never come to the surface again until they are scrap. Under these circumstances the replacing of a tire by shrinking would be difficult, if not dangerous, whereas the pressed-on tire can be easily removed, a couple of jacks can put on the new one, and the rivets hold it fast.

We cannot close this brief account of the special features of these shops without referring to the great strength that is put into these small locomotives. On comparing the sizes and thicknesses of metal used, and the bracing of all parts with similar parts in locomotives intended for heavy service on trunk lines, the first impression is apt to be that one is uselessly heavy or the other ridiculously weak. But when we consider that these locomotives are almost invariably put to the hardest sort of service—that they must run over the rough, temporary track of

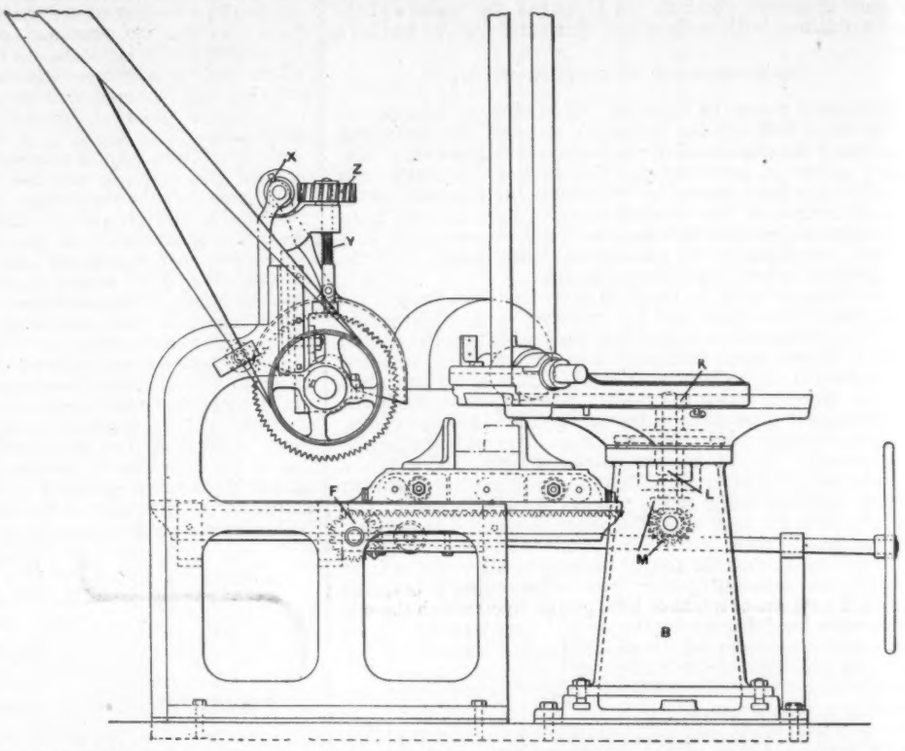


FIG. 3.—END ELEVATION OF BELT-RAIL CHECKING MACHINE, GRAND TRUNK RAILWAY SHOPS.

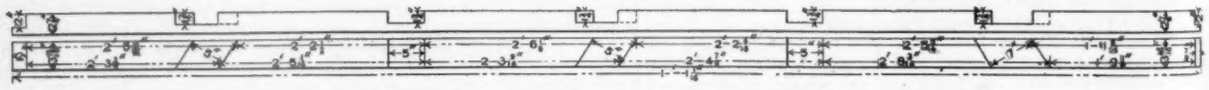


FIG. 4.—BELT-RAIL SHOWING CHECKING, GRAND TRUNK RAILWAY STANDARD BOX CAR.

the contractor, over the cinder heaps and amid the flying dust of steel works and furnaces, or do switching work of the severest kind, like that of the New York & Brooklyn Bridge locomotive illustrated in our last issue; that they are run by all sorts and conditions of men, to whom to apply the name of engineers would be the grossest flattery; that they are banged hither and yon; that they are used to make couplings with the violence of a young collision, and that they have no friends, we can readily understand that this field of locomotive engineering is one that needs careful consideration, and the reason for the large sizes of metal, heavy castings, and rigid bracing becomes apparent. In fact, the output of the shops and the results obtained with it show that this careful study has been made.

THE PITTSBURGH LOCOMOTIVE WORKS.

For several years the shops of the Pittsburgh Locomotive Works have been passing through a series of changes which have finally developed one of the finest and best-arranged locomotive plants in the country. The work of demolition and rebuilding has been carried on without any interruption to the current business of the establishment, and yet in accordance with a prearranged plan that has resulted in the complete establishment, or perhaps we should say "will result," as the changes have not all been effected as yet.

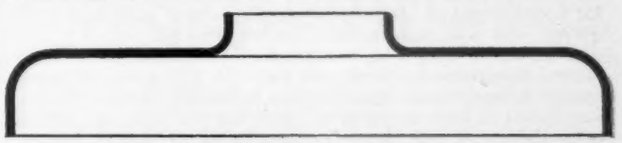
The arrangement of the machine shop has been the subject of so many discussions, and has received so much attention from men interested in economical production, that one type seems to have been generally accepted as best adapted for locomotive and other heavy work. This is the long shop with side bays, in which the smaller tools are placed, while the central space is spanned by a travelling crane having a capacity commensurate with the work to be done, and serving the tools intended for the heavier classes of work. This is the plan adopted at Pittsburgh. This and the other new shops are of brick with iron roofs, and is remarkably well lighted. The windows are in all cases very wide, and the walls between narrow, the ratio of three to one being about the average. Winding in and out among the shops, running to all of the heavier machines, and penetrating every place where material is stored or used, is a system of tracks of 2 ft. gauge, upon which there is a locomotive for doing the hauling. Of coursg these tracks are supplemented by others of the standard gauge leading into the works for the delivery and shipment of materials, but for movements made between different parts of the works the narrow-gauge tracks are used.

The power-house is centrally located, and steam is supplied by ten vertical boilers, that are at present fired with natural gas, though provision is made for firing with coal. These boilers have some peculiarities of construction that render them particularly accessible in all of their parts, and illustrations of which will appear in a future issue. One of them is designed to carry a pressure of 250 lbs. per square inch, and will be used for supplying a pressure for the testing of locomotive boilers. In this power-house, which is not yet entirely completed, is to be located the machinery for driving the entire plant. It is centrally located, and the shafting is to be led off to the several shops. The foundry is one of the finest buildings on the premises, and is equipped with machinery of the latest design. There are three cupolas, the usual complement of cranes and moulding machines. One feature is especially attractive, and that is a depressed core room. The large oven and flues, as they are usually arranged, renders it necessary to block out all the light from one side and most of that coming in from the roof, so that there are always dark places in the core room, where waste material congregates and a litter is sure to prevail. Here the core floor is depressed below that of the foundry floor, so that the tops of the core ovens are on a level with the latter. This leaves the side walls free for the location of the windows and floods the floor with light from above.

At the other end of the shop there are located the moulding machines, which are of both the mechanical and pneumatic type. It has been the prevailing impression that machine moulding was only adapted to simple forms that were to be reproduced in large quantities, but experience has shown that this is not necessarily the case. Of course, metal patterns are the thing for pieces like brake shoes and the like, both on account of the greater durability and ease of manipulation, but wooden patterns of the ordinary type can be employed profitably and with ease. On a double pneumatic machine, like one in use in these shops, for example, two sets of wooden patterns are kept in service, though they need not necessarily be duplicates of each other. One set or one set of halves is placed on a follow board that has holes in it to take the dowel pins or pins to engage in the holes, and they are rammed by the pressure applied. The table swings out of the way, two laborers carry the drag, let us say, to the floor, where a moulder draws the pattern and slicks up the mould; meanwhile, the other halves are placed on their follow board and rammed for the cope, which is carried away, and the first set of halves returned to the machine. The operation is very rapid, hardly occupying more time than it takes to tell of it; and one moulder can keep pace with the machine. It must be borne in mind, in this connection, that, owing to the evenness of the ramming, very little dressing is needed for the moulds and almost no blacking is used, so that the long slow process that accompanies hand labor is entirely done away with and the cost of the castings correspondingly lessened. Of course, where large quantities of any one casting are wanted, stripping plates and the drawing of the pattern by the machine is desirable; but where only a few are desired, machine ramming and hand drawing will be found to be possible and economical.

The show place of this establishment is undoubtedly the forge shop. It is the lightest and airiest place of the kind of which we have any knowledge. The furnaces are fired by natural gas, steam is supplied by vertical boilers similar to those used in the power-house, the forges are well hooded, and the roof is so high and the stacks have such a good natural draft that no smoke or gas escapes into the room except when heavy fires are being made. The room impresses one as being an exhibition, with everything arranged to produce the best possible effect. The machinery is of the type that is usually found in such a place, and every possible facility is offered for the handling of material.

In the boiler shop hydraulic flanging and power riveting prevails. Some of the flanging is done with remarkable skill and shows what fine work can be done with skilful handling even on the lower grades of steel. Tank steel, for example, is used for dome casings and sand-box covers, and even where it has to be drawn as in the accompanying sketch, there is no sign of any tearing or cracking of the metal, while the part subjected to compression is entirely free from crimps. The boiler flanging is done on a press similar to that in use in the



DOME CASING PRESSED FROM TANK IRON, PITTSBURGH LOCOMOTIVE WORKS.

Juniata shops of the Pennsylvania Railroad, to which a reference was made in our issue for June, and embraces all of the flanging for the boiler. While it would probably be impossible for any locomotive shops to have a wide range of distinctive features in the tools with which the work is done, it is shown here that a careful study of the best current practice and the adaptation of that practice to the individual case in hand can be made to produce a shop that possesses the very distinctive and desirable feature of adaptation to the requirements of economical production with the added quality of plenty of light, air, and elbow room, which may and possibly ought to be considered a function of this same economical production.

PROCEEDINGS OF SOCIETIES.

Master Car-Builders' Association.—The Thirtieth Annual Convention of the Association will be held at Saratoga, N. Y., commencing on Wednesday, June 17, 1896, which is one week later than the date prescribed by the by-laws. This change is made after consultation with the Executive Committee of the American Railway Master Mechanics' Association and the unanimous vote of the Executive Committees of both associations in favor thereof. Headquarters will be at Congress Hall, which has made the following terms: Single rooms, $3 per day; double rooms, one person, $4 per day; double rooms, two persons (each) $3 per day. These rates are for members of the Association and their friends. Members of the Association will have preference of rooms until March 1, 1896. Application for rooms should be made to H. S. Clement, Manager, Congress Hall, Saratoga, N. Y., and the Committee of Arrangements requests that members should apply at once for rooms, as those who first apply will be best served.

Engineers' Club of St. Louis.—At the meeting of October 2 Mr. Richard McCulloch read a paper on "The Continuous Rail in Street Railway Service." He described briefly the work done in St. Louis and elsewhere, and the processes em-

ployed. The paper was illustrated by drawings, photographs, rail sections, and samples of joints. Two systems had been employed in St. Louis, electric welding and cast welding. The latter, requiring a less expensive plant, being simpler and easier to operate, and the work appearing to stand service better, had been given the preference. In spite of the extreme temperatures, but a very small percentage of the joints had broken, and these were clearly due to defective welds. The cost was not greatly in excess of the old fishplate method. It was thought that the rail, being surrounded by earth or paving on all sides except the top, it was protected from the extreme variations of temperature, and being held rigidly in position, these two features tended to counteract the expansion and contraction which would ordinarily be expected.

New York Railroad Club.—At the meeting of October 17 Mr. E. E. Russell Trotman read a paper upon "Painted *versus* Planished Iron Boiler Jackets." The data given was very complete, and was obtained from a number of leading trunk lines that have adopted or are using the painted jackets. The conclusions reached from the reports received are that the painted jacket is the superior of the two. It is heavier, and therefore not so liable to be indented or injured by the engine crew; it is less liable to corrode through the action of drippings from roundhouse roofs falling upon it; it requires less labor and attention to keep it clean; it maintains a good appearance longer than the planished iron, and a fresh coat of paint will make it look as good as new, and it may be applied for a very much lower cost than the planished iron, it being reported on one road to cost $17 less than the old style. This, however, is a point in which the personal factor enters, as it depends upon the taste and judgment of the officials as to the elaborateness with which the painting shall be done; this item amounting, in some cases, to so much as to make the painted jacket more expensive than the planished iron, though it is generally conceded that this is unnecessary, both on the score of appearance and economy, for a single coat of Roger's locomotive black is all that is required, and this can be applied for less than $3.

After the reading and discussion of the paper, there was a topical discussion on large box cars, in which the railroads seemed to be opposed to the increase in the size of cars from the standpoint of both economy of operation and revenue derived from them. It was, however, considered of enough importance to warrant the appointment of a committee to report upon the same, which consists of Messrs. Wheatley, Fowler, and Moore.

American International Association of Railway Superintendents of Bridges and Buildings.—At the meeting held at New Orleans, La., on October 16 a report was presented by a committee of which Mr. Walter G. Berg was chairman, on the "Strength of Bridge and Trestle Timbers." It was stated that the wide range of values for the working strengths of timbers by the various recognized authorities is probably due to the unwarranted importance attributed by them in their deductions to isolated tests of small-sized specimens, that were not only limited in number, but which were especially defective in that no data was noted and recorded regarding the exact species of the specimen tested, as well as its origin, condition, quality, the degree of seasoning, the method of testing, etc.

The fact has been proved beyond dispute that small-size specimen tests give much larger average results than full-size tests, owing to the greater freedom of small selected test pieces from blemishes and imperfections, and their being, as a rule, comparatively drier and better seasoned than full-size sticks. The exact increase, as shown by tests and by statements of different authorities, is from 10 to over 100 per cent.

Recently, however, elaborate tests have been made on full-size specimens, and from the data thus obtained the general correctness of the following conclusions is believed to be established:

1. Of all structural materials used for bridges and trestles, timber is the most variable as to the properties and strength of different pieces classed as belonging to the same species, hence impossible to establish close and reliable limits of strength for each species.

2. The various names applied to one and the same species in different parts of the country lead to great confusion in classifying or applying results of tests.

3. Variations in strength are generally directly proportional to the density or weight of timber.

4. As a rule, a reduction of moisture is accompanied by an increase in strength; in other words, seasoned lumber is stronger than green lumber.

5. Structures should be, in general, designed for the strength of green or moderately seasoned lumber of average quality, and not for a high grade of well-seasoned material.

6. Age or use do not destroy the strength of timber, unless decay or season checking takes place.

7. Timber, unlike materials of a more homogeneous nature, as iron and steel, has no well-defined limit of elasticity. As a rule, it can be strained very near to the breaking point without serious injury, which accounts for the continuous use of many timber structures with the material strained far beyond the usually accepted safe limits. On the other hand, sudden and frequently inexplicable failures of individual sticks at very low limits are liable to occur.

8. Knots, even when sound and tight, are one of the most objectionable features of timber, both for beams and struts. The full-size tests of every experimenter have demonstrated, not only that beams break at knots, but that invariably timber struts will fail at a knot, or owing to the proximity of a knot, by reducing the effective area of the stick and causing curly and cross-grained fibres, thus exploding the old practical view that sound and tight knots are not detrimental to timber in compression.

9. Excepting in top logs of a tree or very small and young timber, the heart-wood is, as a rule, not as strong as the material farther away from the heart. This becomes more generally apparent, in practice, in large sticks with considerable heart-wood cut from old trees in which the heart has begun to decay or been wind-shaken. Beams cut from such material frequently season-check along the middle of beam and fail by longitudinal shearing.

10. Top logs are not as strong as butt-logs, provided the latter have sound timber.

11. The results of compression tests are more uniform and vary less for one species of timber than any other kind of test; hence, if only one kind of test can be made, it would seem that a compressive test will furnish the most reliable comparative results.

12. Long timber columns generally fail by lateral deflection or "buckling" when the length exceeds the least cross-sectional dimension of the stick by 20; in other words, the column is longer than 20 diameters. In practice the unit stress for all columns over 15 diameters should be reduced in accordance with the various rules and formulæ established for long columns.

13. Uneven end-bearings and eccentric loading of columns produce more serious disturbances than usually assumed.

14. The tests of full-size long compound columns, composed of several sticks bolted and fastened together at intervals, show essentially the same ultimate unit resistance for the compound column as each component stick would have if considered as a column by itself.

15. More attention should be given in practice to the proper proportioning of bearing areas; in other words, the compressive bearing resistance of timber with and across grain, especially the latter, owing to the tendency of an excessive crushing stress across grain to indent the timber, thereby destroying the fibre and increasing the liability to speedy decay, especially when exposed to the weather and the continual working produced by moving loads.

In addition to the ultimate breaking unit stress, the designer of a timber structure has to establish the safe allowable unit stress for the species of timber to be used. This will vary for each particular class of structures and individual conditions. The selection of the proper "factor of safety" is largely a question of personal judgment and experience, and offers the best opportunity for the display of analytical and practical ability on the part of the designer. It is difficult to give specific rules. The following are some of the controlling questions to be considered:

The class of structure, whether temporary or permanent, and the nature of the loading, whether dead or live. If live, then whether the application of the load is accompanied by severe dynamic shocks and pounding of the structure. Whether the assumed loading for calculations is the absolute maximum rarely to be applied in practice, or a possibility that may frequently take place. Prolonged heavy steady loading and also alternate tensile and compressive stresses in the same piece will call for lower averages. Information as to whether the assumed breaking stresses are based on full-size or small-size tests or only on interpolated values, averaged from tests of similar species of timber, is valuable in order to attribute the proper degree of importance to recommended average values. The class of timber to be used, and its condition and quality. Finally, the particular kind of strain the stick is to be subjected to, and its position in the structure with regard to its importance and the possible damage that might be caused by its failure.

In order to present something definite on this subject, the committee presented a table showing the average safe allowable working unit stresses for the principal bridge and trestle timbers, prepared to meet the average conditions existing in railroad timber structures, the units being based upon the ultimate breaking unit stresses recommended by the committee, and the following factors of safety—viz.:

Tension, with and across grain	10
Compression, with grain	5
" across grain	4
Transverse rupture, extreme fibre stress	6
" " modulus of elasticity	2
Shearing, with and across grain	4

In these tables these factors of safety are worked out to show the actual ultimate strengths of the various materials, as well as the safe loads to which they may be subjected.

OBITUARY

Franklin Leonard Pope.

THIS well-known electrician was instantly killed on Sunday evening, October 13, in his own home at Great Barrington, Mass., by a current of electricity from a converter which was used in connection with the electric-light plant which supplied his house. He went into the cellar after the lights had been turned on to give some attention to this converter. His family upstairs heard a heavy fall, and on going down found him dead on the floor beside the converter.

Mr. Pope was one of the best-informed and practical electricians in this or perhaps any other country, and it is said that he is the first scientific man of prominence to meet his death in this way. Two physicians were summoned immediately after the accident, but their efforts to resuscitate him were of no avail. The exact manner or cause of his death is only a matter of surmise, but must have been due to some defect in the apparatus, as a person with his knowledge would have been incapable of making a fatal mistake.

He was born in the village of Great Barrington on December 2, 1840, and was educated in the local schools of that place, and afterward spent a year at the academy in Amherst, Mass.

He early developed a taste and aptitude for science and mechanics, and it is said that the first money he earned was by making and selling water-color drawings of locomotives on the Housatonic Railroad.

For the following facts in relation to his life we are indebted to the *Electrical World*:

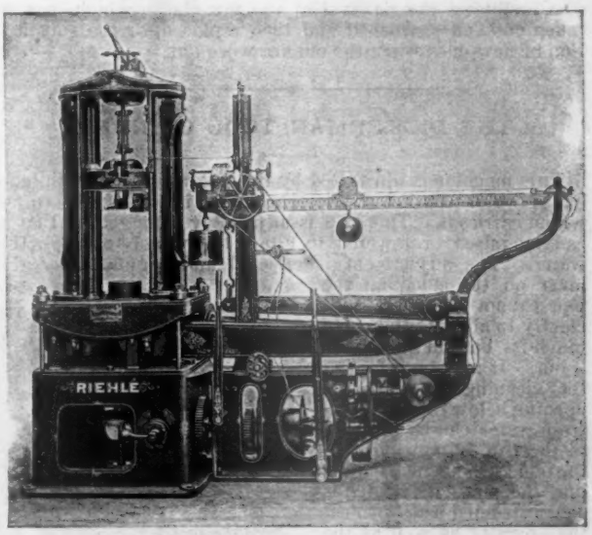
"In 1857 Mr. Pope was appointed operator at Great Barrington in charge of the office of the American Telegraph Company, having for the purpose received instruction in the operation of the Hughes printer. From this position he was transferred to Springfield, Mass., as circuit manager in charge of the line between there and Albany. Early in 1860 he went to New York and was engaged on the *Scientific American* as an artist and writer until after the outbreak of the Civil War, when he again entered the telegraph service as operator at Providence. He became at this time an expert Morse operator, and his unusual ability attracted the attention of General Marshall Lefferts, the Engineer-in-Chief of the American Telegraph Company, who soon transferred Mr. Pope to a more prominent position in the New York office, where he was engaged in the preparation of a series of maps of the whole system of telegraph lines owned by the company.

"During the draft riots in New York Mr. Pope met with many exciting adventures in his successful attempt to restore communication between New York and Boston, the lines in the city having been cut by the rioters. In 1864 he accepted the appointment as Assistant Engineer of the Russo-American telegraph, a projected line from Washington Territory to Siberia *via* Behring Straits, which was partly finished, but abandoned three years later. In this capacity he made an exploration and survey of the southern portion of Alaska in the watershed of the Stiskeen River, going overland in the winter with sledges and dogs from Lake Tatla, B. C. After his return from Alaska, Mr. Pope for some time edited the *Telegrapher*, and also wrote his well-known work, "The Modern Practice of the Electric Telegraph," which has ever since its publication been recognized as the standard authority on that subject. For the decade following his return to New York, he devoted himself to inventions, and in that time organized the gold and stock reporting system, using the Laws instrument; originated private line printing telegraphy, and invented a thoroughly practicable system of electric signals for steam railways, which has since been developed by the Union Switch & Signal Company. Mr. Pope was, in 1885, placed in charge of the patent interests of the Gold & Stock Telegraph Company, but soon accepted a similar position with the Western Union Telegraph Company, in which he remained until 1891, when he engaged in private practice as a patent solicitor and expert. In 1884 he assumed editorial charge of the monthly *Electrician*, the title of which was then changed to the *Electrician and Electrical Engineer*, which position he filled until the spring of 1890. Mr. Pope was a charter member of the American Institute of Electrical Engineers, and in 1886 was elected its second President. Throughout his active career Mr. Pope has given much attention to various historical investigations, and the very thorough manner in which he has brought to light the early work of Davenport, House, and other inventors, has led to the general recognition of the real merit of their labors in the electrical field."

He had been a voluminous writer on subjects relating to his specialty, and had a clear, forcible style that was very attractive to his readers. His extended experience and knowledge gave a practical cast to his writings which is very much lacking in a great deal of the electrical literature of the present day.

During the latter part of his life his services were much sought for in cases of patent litigation. One of the attorneys with whom he was often associated said, "he was a wonderful man, and not too much can be said in his praise; and it is a fact that the quality of his honesty was such that he was not an available witness, though he was the best-informed man in the country. He would insist on telling his ideas on the witness stand."

As a friend and companion he was charming. He had a naïve manner and speech and a kindly, original, and often humorous way of regarding what he observed that was extremely entertaining. Below it all there was a substratum of intellectual and moral integrity which secured the confidence of all who knew him. He leaves a widow, two daughters, a son, and a great many friends who will mourn his untimely death.



THE RIEHLE STANDARD AUTOMATIC TESTING MACHINE.

Manufactures.

RIEHLE UNITED STATES STANDARD AUTOMATIC TESTING MACHINE.

THIS is a very complete machine of moderate capacity, combining automatic weighing apparatus with variable speeds with the latest improved autographic recording device. This machine was first made for hand-power, and in using the automatic attachments belt-power was introduced for the purpose of communicating regular and steady movements to the working parts. A round belt from the counter-shaft drives

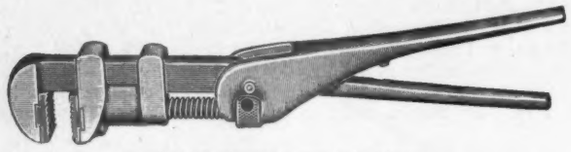
the disk of the weighing apparatus, while a second flat belt is used to transmit the power.

The motion of the poise is transmitted to the diagram by the screw and nut carrying a pencil in a vertical direction, while the stretch of the specimen is communicated by a multiplying extensometre to the vertical drum, causing it to revolve, thus forming a complete strain diagram.

This automatic machine is made in capacities from 20,000 lbs. up to 400,000 lbs. at the Riehle Brothers Testing Machine Company's works, Ninth Street above Master, Philadelphia.

THE WRIGHT WRENCH.

This wrench, which is made by the Wright Wrench Co. of Worcester, Mass., is an adaptation of the monkey-wrench type to the pipe-wrench, and it seems to have been done in a very practical and efficient way. The jaws are faced with toothed or smooth plates, that can be removed when worn, or taken out and replaced the one for the other. The head is moved by a screw and nut, the latter being placed in the enlarged portion of the movable handle, and has bar-holes in it, so that the jaws can be forcibly tightened against the work before



THE WRIGHT PIPE WRENCH.

there is any attempt at turning. The lever in which the nut is placed gives a very long purchase, and every effort to turn the pipe causes an increased tightening of the jaws, as will be seen from an examination of the construction. All parts of the wrench are made to gauge and are interchangeable, so that repair parts can be furnished at a small expense; this also facilitates the removal of the jaw-plates, which may be taken out and sharpened and then replaced, or the substitution of new ones when the old are worn out.

THE DICKERMAN TOOL GRINDER.

This machine is illustrated by the engraving herewith, and has a water-pan below the wheel and inside of the frame which carries it. This pan is adjustably arranged, so that it can be raised or lowered to allow the wheel to touch the water. The adjustment is effected and regulated by the lever on the side, but the pan cannot be raised sufficiently to allow the wheel to touch its bottom and grind it out. It may be removed for cleaning through the opening below the table, and fresh water can be supplied to the pan by pouring it on the table, from which it runs into the pan. The hood is so constructed as to protect the operator as well as the bearings and spindles from water and spray. The table is round, which enables the operator to be at the same distance from his work in whatever position he may be holding the tool to be ground. All the working parts are carefully and accurately finished, the shafts and bearings being extra heavy, and special balancing arrangements are provided for adjusting the wheel.

The machines are made of two sizes: one with a wheel 36 in. diameter and 3 or 4 in. face; the other has a wheel 20 in. diameter and 2½ or 3 in. face. They are made by the Dickerman Emery Wheel & Machine Company, of Bridgeport, Conn.

THE "MONOBAR" CONVEYOR CHAIN.

Monobar is the name given by the Link-Belt Companies to a new chain for long-distance conveying and elevating, which combines strength, lightness, simplicity and durable qualities, and is destined to take a leading place among new and useful

THE DICKERMAN TOOL GRINDER.

appliances for work of this class. Monobar may be briefly described as a series of bolts, flexibly connected, with attachments for conveyor flights or elevator buckets. Fig. 1 shows its appearance as employed in a conveyor, and will suggest to those familiar with chain conveying a superior advantage in that no material can lodge on the chain or be carried under the wheels. Its construction is shown in fig. 2, in which the malleable-iron joint is in light tint, and the abutting ends of

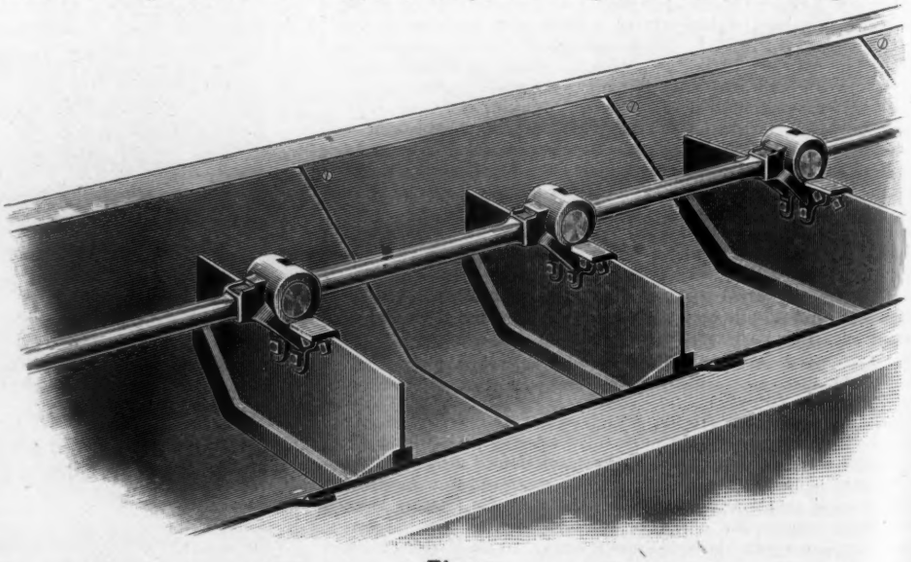


Fig. 1.

THE "MONOBAR" APPLIED TO A SCRAPER CONVEYOR.

the bolts in full shading. Having no welds, which are the chief points of weakness in wrought chains, and the malleable joints being so proportioned as to be in all cases stronger than

the wrought-iron bolts, the strength of the chain is that of a high-grade wrought-iron bolt of the diameter employed. This, for a 1-in. bolt, is about 29,000 lbs. No distortion occurring up to the actual breaking point of the bolts, the monobar is stronger for its weight than any other chain in use. Its design permitting and indicating the use of long bolts, the joints are relatively few, and both weight and wear are consequently reduced. It is detachable at every joint, and readily and quickly assembled or taken apart. Accurate adjustment to pitch is secured by turning the nut on the end of each bolt, and as the nuts are locked while in working position, this adjustment is permanent. The wearing surfaces are larger than in any known chain, and are designed for free lubrication while in motion. There is absolutely no wear on the bolts, so that restoration of the chain to its original condition requires only a renewal of the joints when, after long service, they have become worn out.

The first cost of manufacture being materially less than that of any standard chain for long distance conveying, the invention presents the double advantage of low first cost and cheap maintenance. The claims made for the monobar are substantiated by the record it has made in actual service. Conveyors in which it is employed as a chain, varying in length from 260 ft. to 600 ft. from end to end, have been in operation for some time past. One of them 450 ft. long has been operated for the past six months by the Kidder Coal Company at Wilkesbarre, Pa., in conveying culm from the bank to the washery. The conveyor has been in steady use 10 hours per day, exposed to the weather, and has been run without lubrication or attention. Under date of October 17 the Superintendent of the Kidder Coal Company writes:

"We have used four other styles of chain, and find the monobar conveyor superior to any of them. It is easy to disconnect, and costs practically nothing for repairs. The equalizing gears largely overcome the lashing or uneven motion caused by the long pitch."

The equalizing gears referred to are illustrated in fig. 3, and are of sufficient interest and importance to justify a somewhat complete description. They are designed to give uniform speed to elevator and conveyor chains. They counteract the pulsating motion imparted by the driving-wheels revolving at uniform speed, to chains of long pitch. This jerky motion is inherent in all chain and wheel mechanisms. Unfortunately it cannot be readily counteracted when chains of 6 in. or less pitch are employed, though equally destructive if less noticeable than in case of longer links.

In the illustration a seven-tooth sprocket-wheel is shown driving a chain of 18-in. links. As each link engages the driving sprocket it is controlled by a radius 20¾ in. long, measured

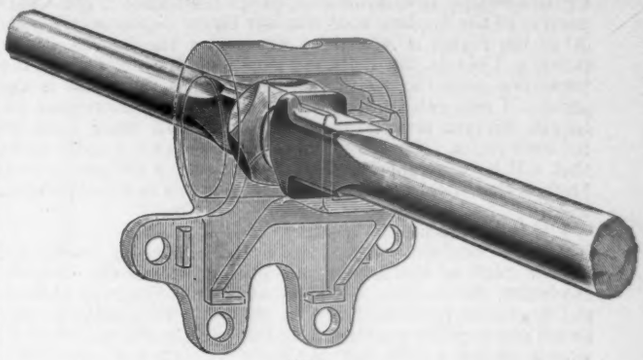


Fig. 2.

A JOINT OF THE MONOBAR CONVEYOR CHAIN.

from the centre of the sprocket-wheel to the centre of the hinge joint of the chain. When the wheel has made one-fourteenth of a revolution (or one-half the movement necessary to bring the next link of the chain into engagement with its sprocket) the controlling radius is reduced to 18¾ in. (measured from centre of wheel to middle of chain link). This action is like that of a connecting-rod, the horizontal movement varying in speed, though the wheel to which it is attached revolves uniformly. If the sprocket-wheel makes 10 revolutions per minute, these alternations of the chain speed occur 140 times per minute, and are necessarily fatiguing and destructive to the chain, producing a violent increase of the normal strain at frequent intervals without any useful result.

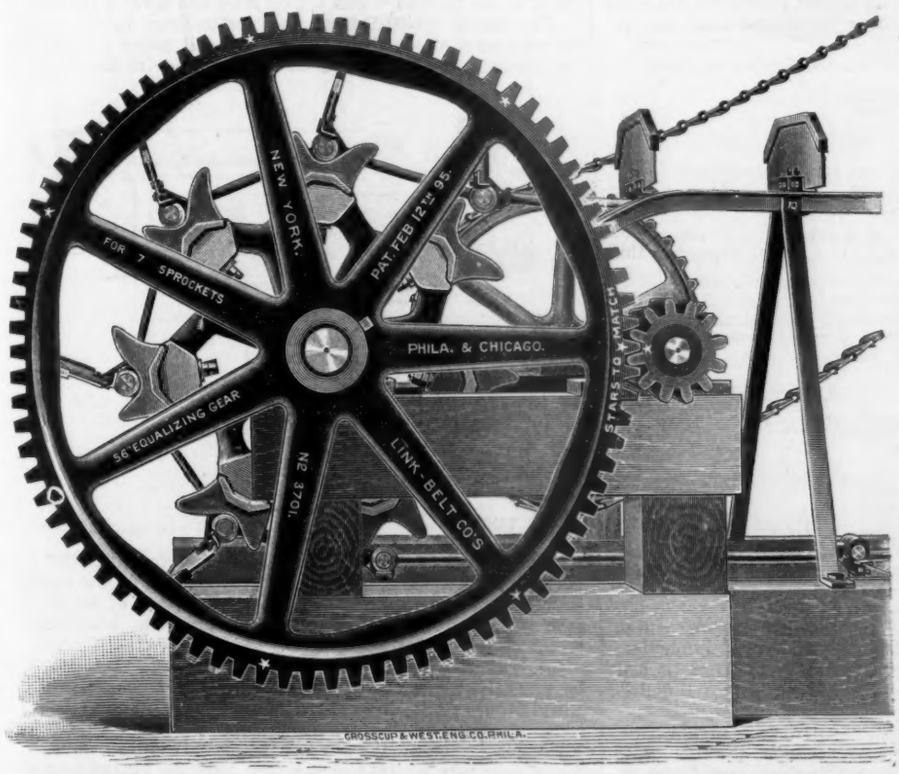


Fig. 3.

COMPENSATING APPARATUS USED WITH THE MONOBAR CONVEYOR CHAIN.

The equalizing gears are designed to impart a pulsating motion to the driving sprocket-wheel exactly counteracting the variations in chain speeds above explained, and this is accomplished by making the pitch diameter of the spur wheel conform to a wave line, the number of elevations and depressions in this line corresponding with the number of sprockets of the chain wheel, and driving the spur-heel with an eccentric pinion as shown in the cut, the sprocket-wheel and spur-wheel being keyed on the head shaft in proper relative positions.

A series of exhaustive tests has developed the facts stated and proved the value of this gearing. By its use less power is required, and the destructive strains due to driving with circular gears is eliminated, thus permitting installations of greater lengths or the use of lighter chains.

The above-described inventions mark a distinct advance in the application of modern methods to the handling of materials.

Recent Patents.

HENSZEY'S IMPROVED LOCOMOTIVE.

MR. WILLIAM P. HENSZEY, of Philadelphia, the well-known manager of the Baldwin Locomotive Works, has patented the improvements in locomotives shown in fig. 1, and which he describes as follows:

"The frame *A* is depressed at *a* in front of the fire box, so that while the portion *A'* is of one level and will readily ac-

commodate the axles of the large driving-wheels, the portion A^3 is on a lower level, and will readily accommodate the axle of the trailer and will extend under the fire-box to the rear of the locomotive, so as to be coupled to the tender. The lower portion of the fire-box rests directly above depressed portions A^3 of the frame A A, and by depressing the frames at the points a, I obtain the increased depth of fire-box and at the same time keep the width required, and as the frame is depressed I can extend the fire-box to the rear, increasing its length without interfering in any way with other parts of the locomotive. Consequently I can construct a locomotive that will have an increased grate area and a uniformly deep fire-box that will give results not obtainable in other locomotives."

The following are his claims:

"1. The combination in a locomotive of the side frames depressed back of the drivers, the driving-wheels and trailers, the boiler, the fire-box, the sides of which are directly above the depressed portion of the frame and within the space between the oppositely arranged driving-wheels and the trailing-wheels, so that a wide and uniformly deep fire-box is obtained which extends forward between the driving-wheels, substantially as described.

"2. The combination of the frames A, A of a locomotive, depressed at a directly in front of the fire-box, the boiler and the fire-box of uniform depth, the side walls of the fire-box being directly above the depressed portion of the side frames and within the space between the oppositely arranged driving wheels and trailers, and having an ash-pit extending between the frames and grate-bars separating the ash-pit from the fire-box, substantially as described."

The patent is No. 545,797, and is dated September, 1895.

slow down or return stroke of the regulator-piston or the bracket.

In order to easily secure the proper adjustment of the regulating apparatus in general, and especially in such particular cases, the mechanism is so arranged that only the absolutely necessary part of the movement of the regulating apparatus, adjusted to a certain stroke, will be imparted to the register 5. In the construction shown in fig. 3 this is effected by the shifting of the position of the axis 11 of a bell-crank lever 12, which serves to establish connection between the regulating apparatus and the register of the furnace-door. Axis 11 of bell-crank lever 12 is situated upon a lever 13, which latter is adjustable by means of a screw 16. As axis 11 is in this manner approached or removed from the operator 3 of the regulator, less or more way is imparted to the register.

The connection between the register and the operator 3 of the regulating apparatus is as follows: The sliding-rod 9 is provided with an adjustable stop 15, whereby it is lifted by the operator. The other end of the sliding-rod 9 is connected to one arm of a bell-crank lever 12, from the other arm of which extends a connecting-rod 8 to a loose sleeve 7′ upon the pivot of the furnace-door. The sleeve 7′ communicates with a second sleeve 7 upon the same axis, which again transmits the movement by a rod 17 to the register 5 upon the furnace-door. The piston of cataract 1 is here raised in opening the furnace-door by means of a chain 20, which connects the furnace-door with operator 3. When the door is closed again, the chain 20 becomes slack and the operator 3 is free to sink back in the time to which the cataract has been adjusted.

The steam emitted from the perforations in the pipe 10 forms a mist above the burning fuel and mixes the air entering through the fire-door above the grate with the fire gases,

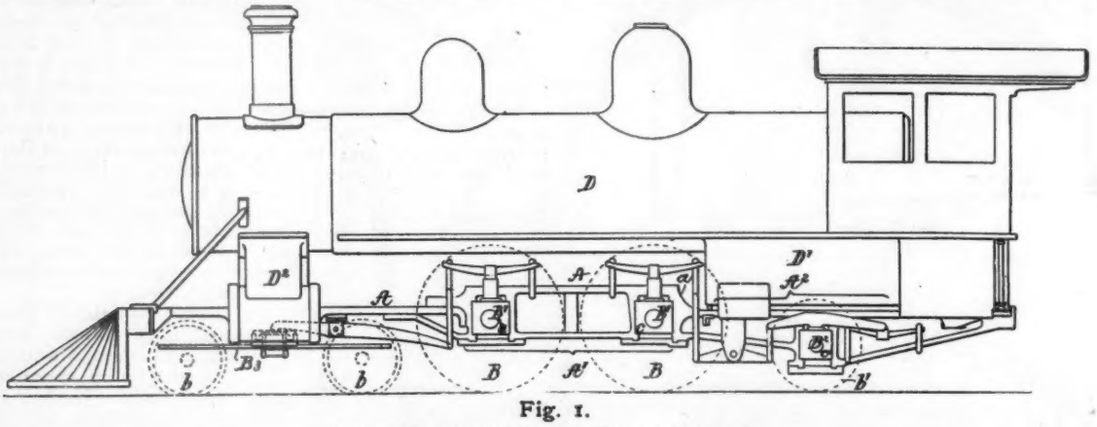


Fig. 1.

HENSZEY'S IMPROVEMENT IN LOCOMOTIVES.

LANGER'S SMOKE-CONSUMING APPARATUS FOR FURNACES.

Mr. Theodore Langer, of Vienna, Austria-Hungary, has patented in this country a smoke-consuming apparatus which consists of a steam-pipe 10, fig. 2, which in locomotive boilers is placed above the furnace-door opening in the back part of the fire-box or near the furnace-door at the top of the fire-box, as shown.

This pipe has perforations which are drilled in such a manner that steam-jets issuing therefrom will strike the tube-plate somewhat below the tubes, as indicated by the arrows in fig. 2. Although it is advisable to let the steam-jets or mist operate continuously, it is within the scope of this invention to insert a valve in the steam-pipe, which valve is operated and adjusted by the movement of an air-regulating apparatus.

The furnace-door 5, fig. 3, has a register for the admission of air to the fire-box. This is arranged so that when the door is opened the register will also be opened, and will then remain open for a short time after the door is closed, and will be closed gradually by an air-regulating apparatus 1, fig. 3. This consists of a cataract, as shown, or of a clockwork, etc., which operates in such manner that a part or bracket 3 of the same, carrying an arm, eye, or other means of connection 2, and which part 3 for brevity is designated the "operator," will within a certain predetermined time perform a certain stroke. This regulating apparatus is connected to the furnace-door, and is operated by the opening or closing thereof. The air-register 5 consists of a slide or door, which is by preference connected with the regulating apparatus 1 in such manner that by the up or inward stroke of the piston or of the part or operator 3 of regulator 1 the register 5 will be opened to a certain degree, and gradually closed again by the whereby a combustion of the smoke is effected. The area necessary for the air-passage after the feeding of the furnace, as well as the time after which the admission of air is to be stopped, must be determined by observation, according to which the regulator is adjusted.

Mr. Charles Brown, of Basle, Switzerland, writes us that he recently took a trip with one of the locomotives of the Rhigi Mountain Railway fitted with the new arrangement for consuming smoke, the invention of a Vienese engineer, Mr. Theodore Langer. "They are being introduced on several Swiss railroads which use the free burning bituminous coal of the Saarbruck Basin, the most outrageous smoke-producer I know of. Langer's apparatus works like magic, and seems to me more practical than the brick arch. It consists of a pipe in the fire-box with holes so as to produce two sheets of steam in the direction of the darts on fig. 2. The fire-door is made with segmental openings, which are opened when the door is opened for charging. At the same time it opens a valve connected with a pneumatic apparatus to keep the register opened for a short time after charging, and allowing it to close gradually as the fresh charge is ignited. It sets up a violent whirlpool in the fire-box and most effectually prevents smoke, and this *without* attention from the firemen."

The numbers of Mr. Langer's patents are 544,765, 544,767, and 544,766, which are all dated August 20.

Messrs. Charles A. Gras & Co., whose address is 61 Broadway, New York., are introducing this invention into this country.

AHERN'S STEAM-BOILER.

Mr. Denis Ahern, of New York City, patented about a year ago the curious boiler which, in the engraving, fig. 4, is

shown adapted to a vessel. From the illustration it will be seen it is substantially cubical in form, and is placed in a diagonal or inclined position, and has two sets of tubes extending through it at right angles to each other. At the lower back end there is a water-leg, *A'*, which forms the back of the furnace, the grate *E* being placed below the cube. The direction and course of the draft is shown clearly by the arrows. Suitable casings *I* and *J* being placed on top and behind at some distance from the boiler, which thus provide space for the passage of the smoke and products of combustion from the top ends of the nearly vertical tubes at *A* to

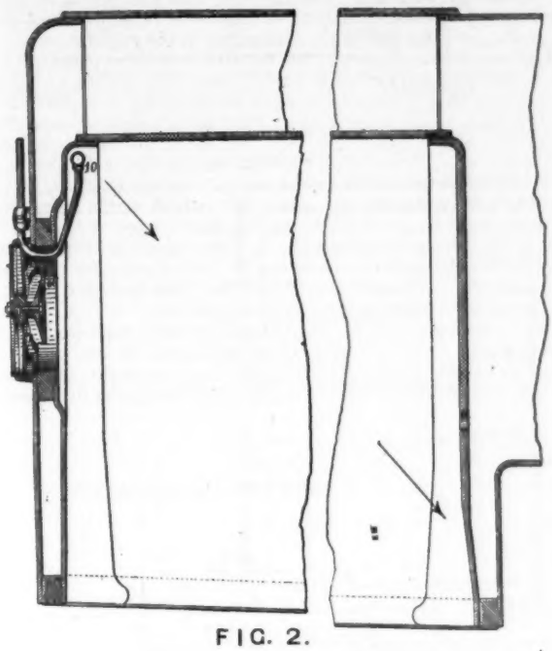


FIG. 2.

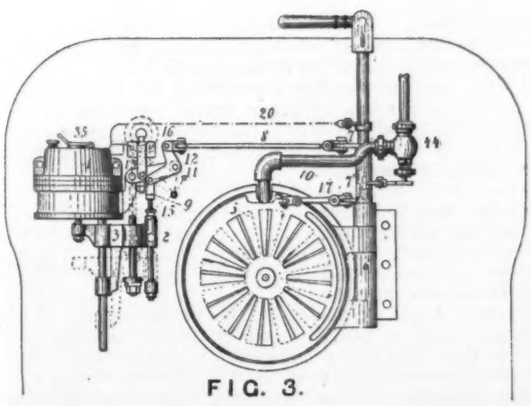


FIG. 3.

LANGER'S SMOKE-CONSUMING APPARATUS.

the lower ends of the horizontally inclined tubes *B*, and thence to the up-take *G'*. *D* is a steam-drum, which is exposed to the contents of the up-take, which thus have the effect of drying the steam. The boiler front is composed partly of horizontal tubes *H*, which are connected to suitable headers H^2, the upper ends of which are connected to the body of the boiler and the lower ends with the water-legs. These connections are, however, not shown in the engraving.

The patent is numbered 528,409, and dated October 30, 1894.

ROHAN'S STEAM GENERATOR.

The boiler illustrated by fig. 5 is the invention of Mr. James J. Rohan, of St. Louis, Mo. Its object, he says, is "to make a steam generator which shall be compact and efficient, and which is also particularly adapted to receive a down-draft furnace."

The boiler consists of a curved hollow shell 5 of a horseshoe form, which is connected to hollow flat ends or water spaces. In the centre of the generator is a cylindrical drum 15, which is also connected to the end water spaces. This drum is connected to the outside hollow shell 5 by radial tubes 16; 19 is a mud-drum, which is connected to the central drum 15 by water-legs 18; 24 is a steam drum suitably supported by

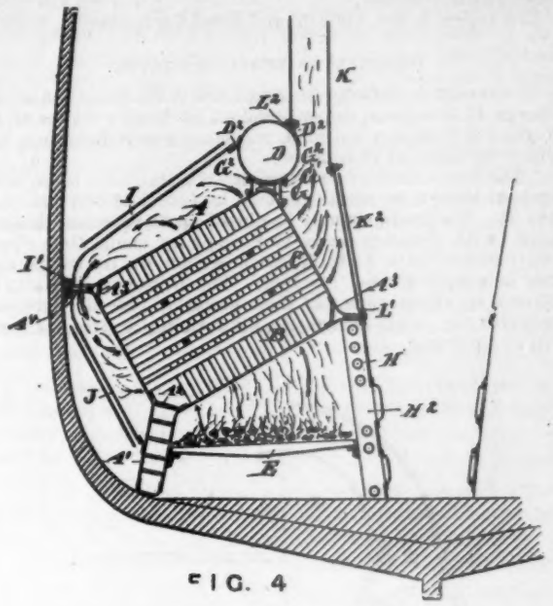


FIG. 4

AHERN'S STEAM BOILER.

tubular standards 23. Below the furnace-door 33 is another cylindrical drum 28, which is connected to the outer casing or of the boiler by vertical pipes 27, and to the central drum 15 by water-tube grate-bars 29. Below these is another grate 30 of the ordinary construction, which has a door 34 through which it may be fed. As shown by the darts, the draft is downward through the water-tube bars, and upward through

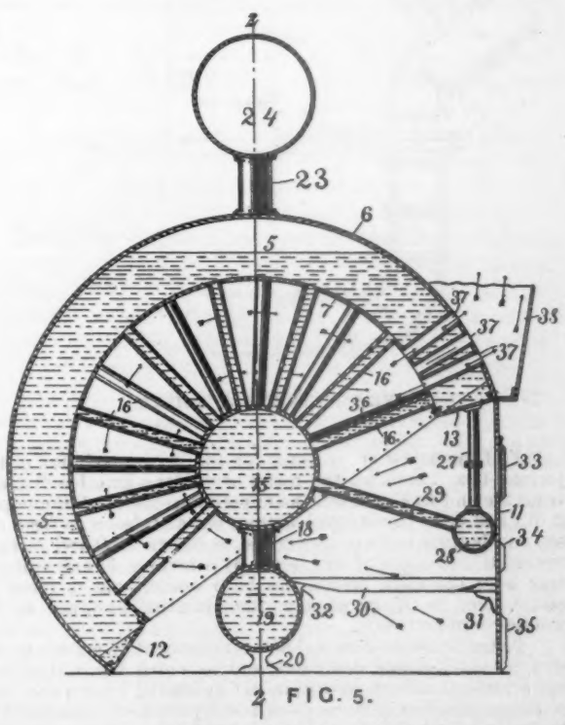


FIG. 5.

ROHAN'S STEAM GENERATOR.

the grate 30; the products of combustion from the two grates meet at 18, and then pass around the central drum 15 and escape through short tubes 37 to the up-take or stack 38. A suitable covering 36 is placed on the tubes 16 to divide the space above it from the furnace below.

Patent No. 546,786, and dated September 24, 1895.

SEE'S WATER-TUBE BOILER.

Mr. Horace See, the well-known mechanical engineer of New York, has patented the form of boiler shown by fig. 6. Its construction is so clearly shown by the engraving that no description is needed.

The patent is No. 546,715, and dated September 24, 1895.

JOUGHINS' RAILROAD CAR-TRUCK.

The car-truck illustrated by figs. 7–9 is the invention of Mr. George R. Joughins, Superintendent of Motive Power of the Norfolk & Southern Railroad, whose address is Berkeley, Va., which he describes as follows :

"The frame mainly of two beams of metal, each beam being bent, as shown, to constitute two half-sides *A* and one transom *B*. The transoms may be placed any convenient distance apart, with distance-pieces and tie-plates connecting them ; but if placed back to back, as shown on the drawings, they may be simply riveted together. The transoms will also require to be slightly bent at their centre to give the necessary space for the usual centre pin, all forming a strong, simple, and cheap frame.

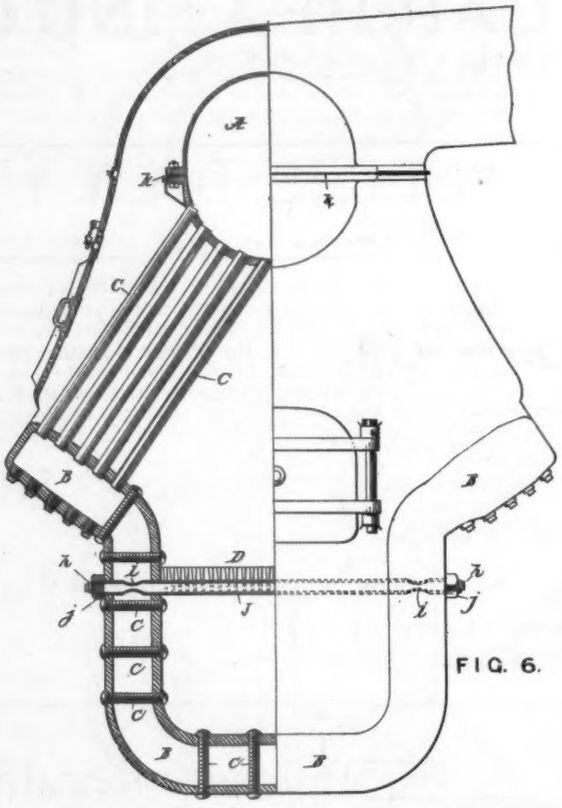


FIG. 6.

SEE'S WATER-TUBE BOILER.

"To form a jaw or pedestal for the accommodation of the journal-box, I split up the metal beam for a suitable distance from the end to *C*, cut out the superfluous material, then open it out and bend the top and bottom parts of beam to form the top and bottom parts of pedestals, as shown at *D* and *F*, then restore the strength of the beam by attaching in any suitable way over the split, which has been opened out, a piece of metal, such as *E*, or of any other convenient form, or by welding a piece into it.

"To facilitate the removal and replacement of wheels in the style of truck-frame described, and in which the journal-box has a vertical movement within the pedestals, I cut away part of the pedestal or jaw, as shown at *G*, for a sufficient height to easily admit the journal-box, leaving the bottom of the jaw permanently closed by prolonging the frame beneath the journal-box, as shown at *F*, so that wheels with attached axles may be rolled out of place as soon as the weight of the car is removed from them. The open space at the end is filled up with a removable piece of suitable shape, as *H*, which forms a shoe or rubbing-piece for the journal-box to rub against."

Number of patent, 547,379, dated October 1, 1895.

TAYLOR'S CAR-WHEEL.

Mr. William J. Taylor, of Bound Brook, N. J., has patented a method of manufacturing car-wheels, of which the following is a description :

"In the production of a wheel of my invention, shown by fig. 10, the ring, rim, or hoop to constitute the tread *a* is made of forged or rolled steel, and preferably of a composition or temper that will not flatten in service, and also that will give

FIG. 7.

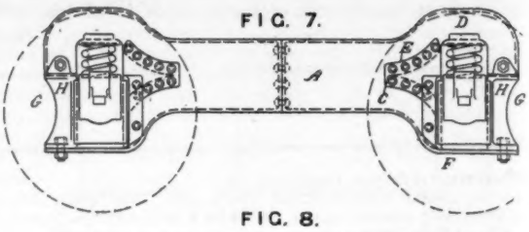


FIG. 8.

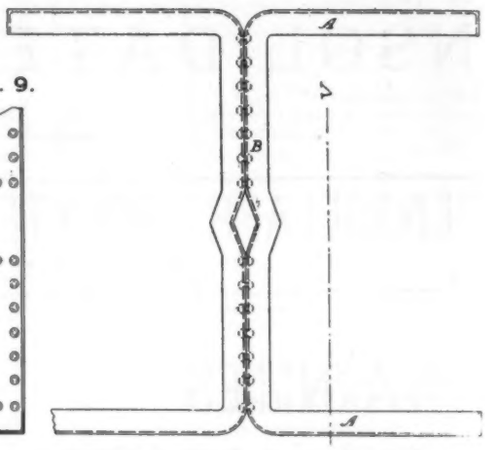


FIG. 9.

JOUGHINS' RAILROAD CAR-TRUCK.

good resistance to wear ; and the flange is made of cast iron, as well as the body of the wheel, the flange being chilled in order to resist tendency to curve-wear in use.

"The mode of making a car-wheel of my invention is as follows : A ring, hoop, or tire of required dimensions and of substantially uniform thickness throughout, as illustrated in fig. 10, or slightly thicker on the edge or side next the flange, to constitute the tread of the wheel, is provided and is heated to required temperature, so as preferably to be welded to molten cast iron in order to form the body and flange of the wheel. This ring, hoop, or tire *a* is then introduced into a mould just before the metal to constitute the body and flange of the wheel is poured. The molten iron by such operation is fused or welded to the hot steel rim or tire, to form with the same one solid structure, while the flange of the wheel is chilled at the same time. It may be here remarked that when the steel ring, hoop, or tire *a*, constituting the tread, is welded to the body and flange of the wheel, it becomes such an integral part of the entire structure that no elongation and consequent loosening of the tire can occur, arising from the wear thereof. In a word, the life and duration of such a wheel is prolonged beyond any wheel hitherto known without apparent or actual flattening of the tread or of undue wear of the chilled flange of the wheel."

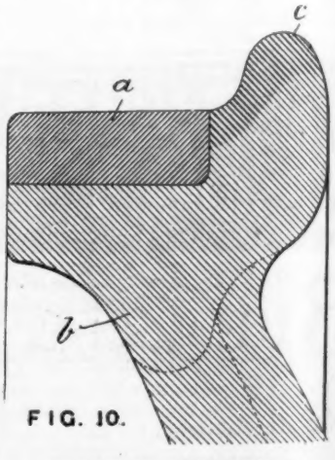


FIG. 10.

TAYLOR'S CAR-WHEEL.

Number of patent, 547,096, dated October 1, 1895.